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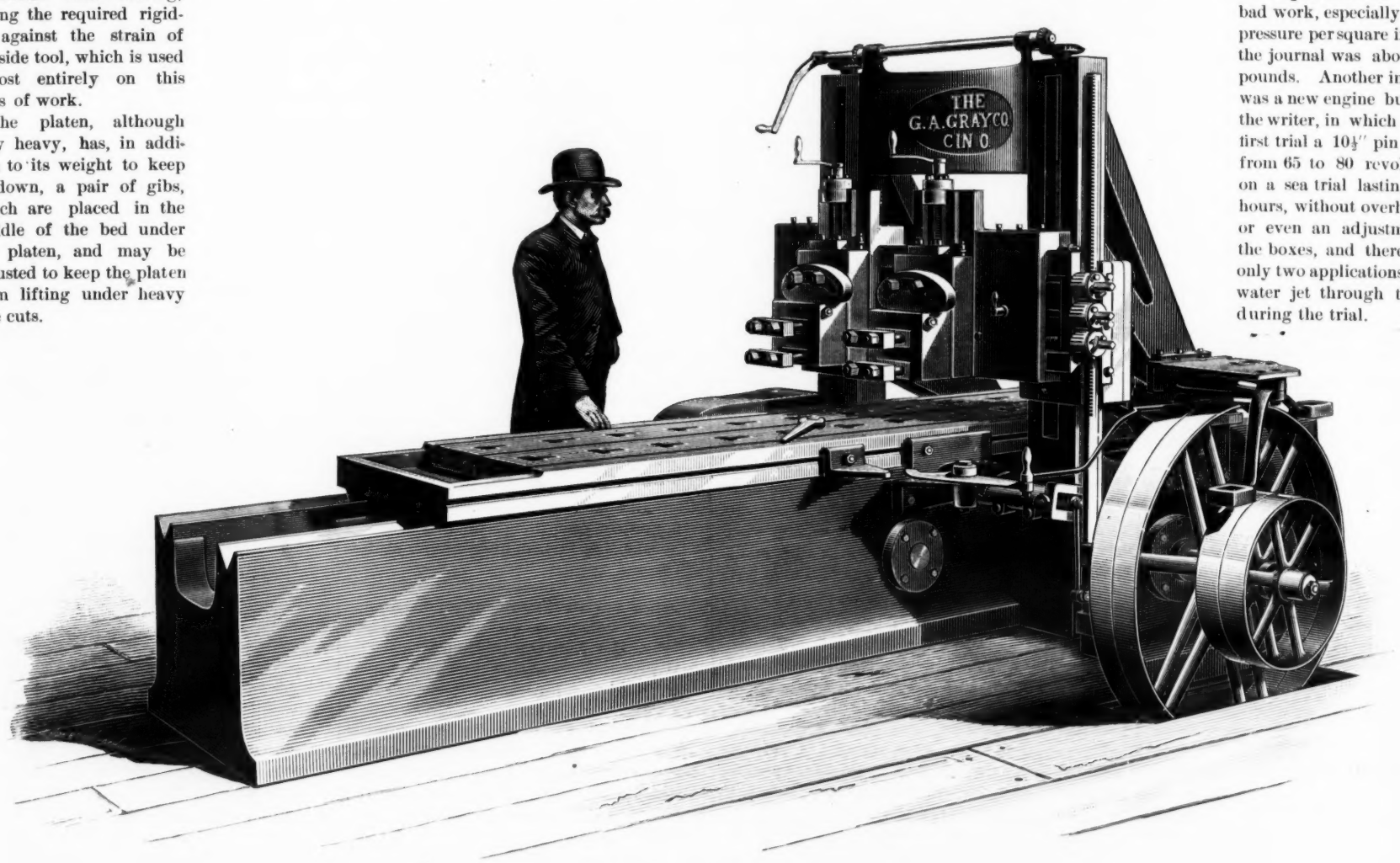
New Railroad Frog Planer.

The cut accompanying this represents a new railroad frog planer, with gibbed platen, built by the G. A. Gray Co., Cincinnati, Ohio. As the illustration is from a photograph made directly from the machine, there is little to be said by way of description.

The machine is very heavy, as may be seen, the bed having a depth of two feet, and is intended to set flat on foundation, without the intervention of legs. The uprights have a width of ten inches on the face where the cross-slide takes bearing, giving the required rigidity against the strain of the side tool, which is used almost entirely on this class of work.

The platen, although very heavy, has, in addition to its weight to keep it down, a pair of gibs, which are placed in the middle of the bed under the platen, and may be adjusted to keep the platen from lifting under heavy side cuts.



NEW RAILROAD FROG PLANER.

The driving pulleys are four feet diameter, with 4½ inch face, and backing pulleys are so proportioned as to give a quick return of three to one. All the gearing is very heavy, the rack and wheel being three inches pitch, with nine inches face. All pinions are cut from solid steel forged under the hammer.

The cross rail has a width of eighteen inches; saddles are two feet square; tool box is eleven inches wide, and has two heavy steel clamps, held by four bolts one and a-quarter inch diameter, for clamping the tools.

These machines are made to take thirty-six inches wide and high, and to plane fourteen feet and sixteen feet long; weight, about 40,000 pounds.

It is acknowledged by an English engineering journal that the progress which is made in this country with electric lighting is enormous, when compared to what is being done in England.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

FIFTH PAPER.

We have fixed the size of our main crank shaft journals on a basis of 400 pounds' working pressure per square inch, although, allowing for the average back pressure calculated from the initial and terminal back pressures, the actual journal pressure will rarely be over 370 pounds per square inch.

Coming to the proportions of the crank-pins, we must provide sufficient surface to insure long continuous running, as these important members on our proposed engine are traveling in a 54″ circle at a rapid pace, and are therefore not readily examined in case of heating, while the shaft journals revolve in stationary boxes, that can always be readily reached, and the lubrication closely watched. A crank-pin must be made no larger than necessary for safe work, for the reason that its weight must be kept at a minimum. Considering the above conditions, I have always made it a practice to deduct from the absolute initial piston pressure 33 per cent. when calculating the size of triple expansion marine engine crank-pins. Of course this deduction represents a portion of the back pressure between the initial and intermediate cylinders. Our absolute initial pressure being 175 pounds, and making a deduction of 33 per cent., we find we have a total load on the initial piston of 62,000 pounds, which, of course, is transmitted to the high pressure crank-pin, and this load, divided by our working factor of 400 pounds per square inch, calls for 155 square inches of actual pin surface. As in the case of the shaft journals, we must add 30 per cent. to this surface, to allow for errors in fitting, etc., so we must really have a pin that will measure 200 square inches.

The care taken as to the length of the crank-shaft journals must be observed in designing the crank-pins, and for this reason the crank-pins on the modern triple expansion engine will often be found to be larger than the shaft journals. We will, therefore, distribute the 200 square inches on a pin 13½ inches in diameter, and 15 inches long. The portion of the pins extending into the crank-arms or plates will be enlarged to the same size as the body portion of the crank-shaft, which is 15¼ inches, while the corners must be rounded up from the pin surface to the body, with the same radius as that of the shaft.

The pins should be forged of the best quality of mild steel. After forging, they should be bored and reamed to fit a 5″ standard turning arbor. On this arbor the pins should be turned and ground to size. The boring of a crank-pin insures strength, as all central imperfections are removed, and any extending flaws can be discovered before the turning and finishing of the pin is begun. This central hole can be used for lubricating and cooling the pin in case of heating, and it removes a large portion of the useless weight always present in large crank-pins.

The writer fitted five marine engines with hollow crank-pins in 1882 and 1883, and in every case these pins worked perfectly under the most trying conditions. During an extended speed trial, and when all the engine crank-pin journals were quite new, a set of 5½″ crank-pins with 2″ holes entirely through them were several times almost instantly cooled, by a short application of the water jet, the stream passing through the pin. Now 5½″ pins running continuously for six hours at 165 revolutions is not bad work, especially as the pressure per square inch on the journal was about 468 pounds. Another instance was a new engine built by the writer, in which on the first trial a 10½″ pin made from 65 to 80 revolutions on a sea trial lasting nine hours, without overheating or even an adjustment of the boxes, and there were only two applications of the water jet through the pin during the trial.

The raising of the ends of the pins above the journal surface enables us to make ample key fastenings without weakening the pin, and the same is true of the crank-shaft sections where they enter the crank-arms or plates.

The next in order are the crank-pin boxes, and connecting rod, for they must both be considered together in order to make the explanations clear.

The crank end of the connecting rod is one of the most important details of a marine engine. It must be strong, and as light as conditions will permit, and by all means easy to adjust and repair. Surely these combined conditions are somewhat difficult to meet, and there is probably no part of the machine that requires more thought in designing. Sea service has always been severe on the propelling machinery, but within the past fifteen years the labor has been increasing, until now we have the most exacting duties ever presented in the long and brilliant history of

marine engineering. From 1868 to 1878 the marine boiler pressures were more than doubled, as they went upward from 35 to 90 pounds, and within the past four years they have been doubled again.

From 40 revolutions on a 5 foot stroke screw engine, we now have 68 revolutions per minute on a 6 foot stroke engine, both of the vertical type. Propeller wheels have advanced from 20 feet to 35 feet pitch, and crank-shafts from 16″ to 21″ diameter. Of course the connecting rods of the old designs and proportions were not suited to the new requirements, consequently there has been a thorough revision of the connecting rod designs.

What has generally been called the "English end," for the crank end, is probably the most popular, and I consider it justly so. It is exceedingly strong, very simple in construction, and easy to repair. It can be made lighter than any other marine rod, and can be disconnected quickly in case of accident. There is, however, more than one style of "English end," and I will here describe one of the original, and a few of the late designs. One of the oldest types of this connecting rod was used on the oscillating and side lever marine engines built twenty-five years ago. These were ponderous compared with the present designs, as they had no large steel forgings then, and therefore made up in quantity what they lacked in quality.

The steamship "Great Eastern" had the old style "English end" on both her paddle and screw engines. This ship was begun in 1854 and completed in 1859. She was 680 feet long, 83 feet beam, and 58 feet deep. At 28 feet draft her displacement was 24,000 tons measurement. Her boilers contained 44,000 square feet of heating surface. The paddle engines were four in number, each having a cylinder 74″ diameter and a piston stroke of 14 feet. There were four screw engines also, each having a cylinder 84″ diameter, and a piston stroke of 4 feet. The combined power of these engines was 10,340 indicated horse-power, and the speed of the ship about 14 knots per hour.

To digress a little, let us compare the above dimensions with one of the latest English steamships, completed, I think, in August of last year for the East India trade.

This new vessel is 482 feet long, 52 feet beam and 37 feet deep. Displacement 6,500 tons. She has a three crank (120°) angle triple expansion engine, as follows: High pressure cylinder, 46″ diameter; intermediate cylinder, 73″ diameter; low pressure cylinder, 112″ diameter, and a stroke of 6 feet on all pistons. She has developed 9,000 horse-power, and has made 18 knots per hour on regular work, and in a trial developed 10,210 horse-power. Regular boiler pressure 160 pounds. Thus it will be seen that this new ship with a little over a quarter of the displacement of the "Great Eastern," has as much power in three cylinders as the latter ship had in eight, and two of these are smaller than those of the big vessel.

It will be noticed that the "Great Eastern" had but $\frac{47}{100}$ of a horse-power for each ton of displacement, while the modern ship just cited has $1\frac{4}{10}$ horse-power for each ton of displacement. It is said the new Inman and White Star steamships will have $1\frac{85}{100}$ horse-power per ton of displacement.

The top end of the piston rods on the oscillating paddle engines of the "Great Eastern" were fitted with the "English end," and both ends of the rods on the screw engines were of similar design, which was one of the first patterns. This consisted in making two half boxes to clasp the pin journals, and on either side of these was a heavy forged block. Through this mass of brass and iron, and on each side of the pin, and close to it, passed a turned bolt or rod which was extended to the crosshead boxes, passing through them in the same manner. Distance collars were forged on these rods, and the boxes drawn against them by heavy nuts with lock rings.

A second form of this rod, and one used in naval ships, dispensed with the forged caps, and brought the boxes down on the collars, and a third form had but one bolt or rod directly in line with the pin centers, and screwed or keyed to the inner half boxes, the outer half boxes being held on by two regular cap bolts.

The new "English rod," or the one used for the past fifteen years, has a yoke end for the crosshead end, and is forged in one piece, with the exception of the cap on the crank end. The main center of the rod is generally round in section, and tapered from each end to the center, though some builders taper from the crank-pin butt to the yoke end. Some have a rectangular section tapered in the widest direction upward. Some are rectangular in section, with the center milled out, like the new locomotive rods.

Most any of these designs are good, and cheap to build compared with a strap connection. The lower end is simply a tee head, forged to the center body of the rod. The upper yoke end is opened wide enough to receive the crosshead boxes, and the crosshead pin is made fast in the yoke. The crosshead boxes are held in the steel piston forging, with a cap similar to the one on the lower end of the connecting rod. This combination for the main transmission has advantages that are found in no other, and it has been thoroughly tried for years. It is cheap to construct, easy to adjust and repair, and safe in heavy weather.

Shop Notes.

Upon a recent visit to the works of the Billings & Spencer Co., at Hartford, we found them busy and making a very large and constantly increasing variety of drop forgings for almost every conceivable purpose.

The smallest forging they are at present making is used on a type-writer and weighs one-sixteenth of an ounce; the heaviest is the connecting rod of the Westinghouse engine, and weighs 40 pounds.

The making of drop forgings for electrical work out of pure copper has grown into an extensive business, and about five tons of copper per month are now used up in making commutator bars and segments. Unalloyed copper is best for this purpose, but it had not been available because the bars were of such shape that it was considered necessary to cast at least a part of them, afterwards brazing the parts together to form the complete bar.

Since pure copper cannot be cast, they were made of an alloy containing as much copper as would admit of its being cast. Mr. Billings happening into a shop where they were making commutator bars in this way, offered to make them of a solid piece of pure copper—a proposition which nearly took the breath away from the Swedish electrician who was doing the work, but which, notwithstanding his skepticism, led to the present business of drop forging them, and the entire abandonment of the old method.

Forty-three varieties of sewing machine shuttles have been made here; four of them for sewing machine builders in England, who freely admit their superiority over anything in that line obtainable in England.

The machinery and tools for making these shuttles and the bobbins are quite interesting to the mechanic, the latter being made entirely by automatic machinery. The steel wire is fed into a machine which automatically cuts it off to the right length, and shapes the ends to the proper form, after which the pieces go to a machine which hardens the ends. They are here placed in an inclined box, the width of which equals the length of the wires; at the lower end of this box is an opening wide enough to admit the edge of a wheel which has across its face little notches or teeth, just wide and deep enough to hold one wire. This wheel is about 12 inches diameter, and as the edge of it passes slowly up through the box, a wire falls into each notch. The wheel is somewhat narrower than the length of the wires, so that the length which it is desired to harden at each end projects out over the edge of the wheel, and by its continued revolution they are carried over to the opposite side, where the flames from two Bunsen burners are directed against them, and the ends heated.

They are held in place meantime by a flat spring which encircles this part of the wheel, and just as they are heated to the proper point for hardening, they reach the end of the spring and drop into a tank of water. Another machine makes the brass washers, drilling the holes, shaping the washers, and cutting them off from a brass rod automatically. Seventeen years ago when Mr. Billings started the manufacture of these bobbins, all these operations were performed by hand, not so well as now, and at double the cost, they being furnished now at from $5 to $7 per thousand.

In what Mr. Billings calls his "die house" there are about 100 tons of drop and trip-hammer dies, which are placed there for safe keeping when not in use, the form of the impressions in many of them having become familiar to mechanics, soldiers, sportsmen, wheelmen and others throughout most of the civilized world.

We were shown some specimens of steel tubing, parts of which had been reduced in diameter under dies, the effect of the operation being somewhat remarkable. There seems to be little or no tendency to lengthen the tube, when its diameter is reduced in this manner, but the surplus stock is taken up by the thickening of the reduced portion. One specimen was a piece of steel tube about three inches diameter, and six inches long, about four inches of which had been drawn down to about an inch in diameter, leaving a portion at each end the original size. Good shoulders were formed, not being over 3° from square. We saw also a "box" for a vehicle wheel, which had been made of a piece of weldless steel tube reduced to the proper taper under dies, and flanged.

In the fire-proof storeroom where the finished stock is kept, is an exhibit, which, on account of its great variety, and the elegance and finish of the articles, is quite interesting to the mechanic, especially when we consider that, notwithstanding the antiquity of the art of forging, this is all the product of an art which has been acquired within a comparatively few years, and has reached its highest development in this country.

A good deal of the work is polished, and, as a protection from rust, had been given a very light coating of vaseline. This is a new substance for that purpose, and serves admirably, a light coating of it being colorless and scarcely perceptible yet being an effectual and complete protection. After trying nearly everything else they consider it the best, a fact which many of our readers will be glad to know.

Notes on the Expansion of Steam.

BY RICHARD H. BUEL.

THIRD PAPER.

It is not unusual to lay off the theoretical expansion and compression curves upon indicator diagrams, and this can be done by calculation, as already explained. But graphical methods of constructing the curves are sometimes more convenient. Both methods, the graphical and the arithmetical, are illustrated below.

The graphical constructions of the isothermal curve of expansion are numerous, as the reader is doubtless aware, and only two of the simplest are here presented. The constructions are made upon actual indicator diagrams.

In Fig. 2, page 3, the indicator diagram, *A B C D E*, from a condensing engine, is given. *F G* is the vacuum line, and the clearance is $3\frac{1}{4}$ per cent. of the piston displacement. It is required to draw the isothermal curve of expansion. For this purpose, limiting perpendiculars are erected on the vacuum line, thus fixing the length, *F G*, of the diagram. The length of the diagram is then increased by a distance, *F I*, equal to 0.0325 of *F G*, and a perpendicular *I H* is erected to *I G*. Evidently, *F I*, or *a H*, represents the equivalent length of clearance, *F G* representing the stroke of the engine. Through *B*, the point of cut-off, which must be selected by inspection, a perpendicular, *M b*, is drawn, and a horizontal line, *H b*, is drawn through the point on the diagram representing the maximum pressure before cut-off. All the data for the construction of the isothermal curve of expansion are now at hand. Divide the perpendicular *H I* into any even number of equal parts, in this case 8. Produce the line *H I* to *K*, making *I K* one-half of *H I*, and dividing *I K* into parts equal to the divisions of *H I*. From *K* draw the horizontal line, *K L*, and from *b*, the theoretical point of cut-off, draw a straight line through *c*, the middle point of *H I*, cutting the horizontal line drawn from *K*, in the point *L*. Draw horizontal lines from the several points of division of *H I*. From *L* draw a straight line through *d*, and the point *l*, in which the line cuts the horizontal drawn through the first point of division of the line *H I*, is one point of the required curve. Similarly, *m*, the point in which a straight line drawn through *L* and *e*, cuts the horizontal line drawn through the second division of *H I*, is another point of the required curve. The points *n*, *o*, *e*, are found in a similar manner, and a curve, *b l m n o e*, drawn through these points, is the required isothermal curve of expansion.

Fig. 3 illustrates the application of this method of construction to the theoretical curve of compression. The given indicator diagram from a non-condensing engine, is *A B C D E*, the atmospheric line is *F C*, the compression ceases at *E*, and the clearance is 10 per cent. of the piston displacement. Assuming the pressure of the atmosphere to be 14.7 pounds per square inch, the perpendicular distance, *C O*, between the atmospheric and vacuum lines is 14.7 divided by the scale of the diagram. Thus, if the scale is 40 pounds to the inch,

$$C\ O = \frac{14.7}{40} = 0.37 \text{ inch.}$$

Make *P L*, $\frac{1}{10}$ or 10 per cent. of *P O*, and erect a perpendicular *L H*. At *E*, the point where compression ceases, draw a horizontal line *E K* cutting the perpendicular *H L* at *K*. Divide *K L* into any even number of equal parts, produce *H L* to *M*, making *L M* = $\frac{1}{2}$ *K L*. Draw a horizontal line *M N*, from *M*. Through *E* and the middle point of *K L* draw a straight line *E c N*, cutting *M N* in the point *N*. Then proceed to construct points *h*, *i*, *k*, *l*, *m* of the required theoretical compression curve in the manner previously explained.

For short cut-offs and for most cases of compression, the construction shown in Fig. 4 will be found very convenient. *A B C D E* is the given indicator diagram, from a condensing engine, and *F G* is the atmospheric line. The clearance is $1\frac{6}{10}$ per cent. of the piston displacement, and *H K* is laid off, 0.016 of *H I*, the length of the diagram. The vacuum line is drawn, making *C I* equal to 14.7 divided by the scale of the diagram, and on the line *K I*, produced, are laid off any number of equal spaces, each equal to *K N*, the distance from commencement of stroke to cut-off, plus clearance. Perpendiculars are erected at each point of division, and from *M*, the theoretical point of cut-off, straight lines *M c*, *M e*, *M g*, etc., are drawn to the several divisions of *K I*. The point *b*, where the straight line *M c* cuts the perpendicular erected on the preceding point of division of the line *K I*, is one point of the required curve; *d*, where the straight line *M e* cuts the perpendicular erected at *c*, is another point, and in similar manner, other points *f*, *h*, *k*, *m*, *o*, *q* and *s* are determined, and the curve drawn through these points is the required isothermal expansion line.

The diagrams shown in Figs. 2, 3 and 4, are all taken from well-known automatic cut-off engines, and are fair specimens, according to the writer's experience, of the ordinary action of such engines. The reader will observe that they are not as good as the diagrams usually published in the trade catalogues of engine manufacturers, and it is not unlikely that the latter diagrams were taken under exceptional circumstances.

Many engineers prefer to lay off the theoretical diagram by calculation, and this method will now be illustrated by an example.

Let the data be as follows:

Diameter of cylinder=12 inches.

Stroke=24 inches.

Clearance=3 per cent. of piston displacement.

Back pressure=10 pounds per square inch.

Initial pressure=40 pounds per square inch. (Pressures are absolute, above a vacuum.)

Admission valve closes three inches from commencement of stroke.

Exhaust valve closes two inches from termination of return stroke.

The apparent cut-off in this case is

$$\frac{3}{24} = \frac{1}{8}.$$

The real cut-off is

$$\frac{3 + 0.03 \times 24}{24 + 0.03 \times 24} = 0.150.$$

Generally, calling D the distance from commencement of stroke to point of cut-off, S stroke of engine, c fraction of clearance, R real ratio of expansion, and r apparent ratio of expansion.

The apparent cut-off

$$\frac{1}{r} = \frac{D}{S}$$

The real cut-off

$$\frac{1}{R} = \frac{\frac{1}{r} + c}{1 + c}$$

In the present example,

$$\frac{1}{R} = \frac{\frac{1}{8} + 0.03}{1.03} = \frac{0.155}{1.03} = 0.150.$$

The real ratio of expansion,

$$R = \frac{1.03}{0.155} = 6.65.$$

It is assumed that the curve of expansion follows Mariotte's law, the pressure being inversely as the volume. If P is the absolute initial pressure, S the stroke, x any distance beyond the point of cut-off from commencement of stroke, p the absolute pressure at the distance x and D the distance from commencement of stroke to point of cut-off,

$$p = P \times \frac{D + c \times S}{x + c \times S}$$

Applying this formula to the present case, observing that $c \times S = 0.03 \times 24 = 0.72$, the pressures at each inch of stroke beyond the point of cut-off are calculated as below:

At 4 inches,

$$p = 40 \times \frac{3.72}{4.72} = 31.5.$$

At 5 inches,

$$p = 40 \times \frac{3.72}{5.72} = 26.0.$$

At 6 inches,

$$p = 40 \times \frac{3.72}{6.72} = 22.1.$$

and so on, giving the pressures:

At 7 inches, 19.3; at 8 inches, 17.0; at 9 inches, 15.3; at 10 inches, 13.9; at 11 inches, 12.7; at 12 inches, 11.7; at 13 inches, 10.8; at 14 inches, 10.1; at 15 inches, 9.5; at 16 inches, 8.9; at 17 inches, 8.4; at 18 inches, 7.9; at 19 inches, 7.5; at 20 inches, 7.2; at 21 inches, 6.9; at 22 inches, 6.6; at 23 inches, 6.3; at 24 inches, 6.0 pounds per square inch above a vacuum.

Fig. 5 represents graphically the results of the preceding calculation, with some other items, which will be explained.

In this figure $F\,E$ is the vacuum line, of any convenient length, divided into 24 equal parts by perpendiculars, as shown. $F\,L$ is $\frac{3}{180}$, or three per cent. of $F\,E$. A scale of pressures is fixed, and $G\,H$ is laid off, to represent the line of back pressure. $F\,A$ is made equal to the initial pressure on the scale, and $A\,B$ is drawn, including three perpendiculars, thus representing the fraction of stroke completed up to point of cut-off B. The pressures previously calculated are then laid off on the remaining perpendiculars, above the line $F\,E$, and a curve $B\,C\,D$ is drawn through the points so determined. This is the theoretical curve of expansion.

At K, two inches before the completion of the return stroke, the exhaust valve closes, and the steam is compressed during the remainder of the stroke in a curve $K\,N$, laid off by the following calculation:

Pressure at K, 2 inches from termination of stroke = 10 pounds per square inch.

Pressure at 1 inch from termination of stroke

$$= 10 \times \frac{2.72}{1.72} = 15.8.$$

Pressure $F\,N$ at termination of stroke = final cushion pressure

$$= 10 \times \frac{2.72}{0.72} = 37.8.$$

The rule for finding the mean total pressure of the diagram $I\,B\,D\,E\,L$, where R is the real ratio of expansion, and P the absolute initial pressure, is

$$\text{Mean total pressure} = P \times \frac{1 + \text{hyperbolic logarithm } R}{R}$$

The hyperbolic logarithm of a number can be found from the tables usually contained in engineers' pocket-books, or it can be calculated from a table of common logarithms, remembering that the hyperbolic logarithm of a number is 2.3026 times the common logarithm of the same number. In the example under consideration $R = 6.65$, and the hyperbolic logarithm of $R = 1.895$, hence the mean total presssure

$$= 40 \times \frac{1 + 1.895}{6.65} = 17.4$$

pounds per square inch.

The mean effective pressure, uncorrected for clearance and cushion, or the mean height of the figure $I\,B\,C\,G$, is evidently obtained by subtracting the back pressure from the mean total pressure calculated above; hence it is 17.4 — 10 = 7.4 pounds per square inch.

To correct the diagram for clearance, that is, to find the mean height (M) of the diagram $A\,B\,C\,G$, having given the uncorrected mean effective pressure (m), the initial pressure (P), and the fraction of clearance (C), make $M = m - c \times (P - m)$; or, in the present case,

$$M = 7.4 - 0.03 \times (40 - 7.4) = 6.4.$$

It will be noticed that the only part of the diagram which represents useful work is that which lies above the back pressure line $G\,H$, so that, for a portion of the stroke represented by $C\,H$, the back pressure exceeds the positive pressure on the piston. This is one of the effects of an early cut-off, or a low initial pressure of steam, and is usually caused by the employment of an engine which is too large for the work to be done.

The point C, in which the expansion curve cuts the back pressure line $G\,H$, is readily calculated, knowing the absolute initial pressure (P), the back-pressure (b), the distance from commencement of stroke to point of cut-off (D), the fraction of clearance (c), and the stroke (S). From these data,

$$G\,C = x = \frac{P \times D + (P - b) \times c \times S}{b}$$

For the present case,

$$G\,C = \frac{40 \times 3 + (40 - 10) \times 0.03 \times 24}{10} = 14.16 \text{ inches.}$$

Knowing the distance from termination of stroke to commencement of cushion (d), the fraction of clearance (c) and the stroke (S), the ratio of compression or cushion (N) is found by the formula

$$N = \frac{d + c \times S}{c \times S}$$

or, for the assumed data,

$$N = \frac{2 + .03 \times 24}{0.03 \times 24} = 3.78.$$

The hyperbolic logarithm of 3.78 = 1.33, and if the final cushion pressure (C) is given, the mean absolute cushion pressure (a), or the mean height of the figure $N\,K\,M\,F$, is

$$a = C \times \frac{\text{hyperbolic logarithm } N}{N - 1}$$

or,

$$a = 37.8 \times \frac{1.33}{2.78} + = 18.1$$

pounds per square inch.

From the mean absolute cushion pressure (a) the back-pressure (b), the fraction of clearance (c), the ratio of compression (N), and the mean effective pressure corrected for clearance (M), the mean pressure corrected for back pressure, clearance and cushion (F), or the true theoretical mean effective pressure = the mean height of the effective diagram, $A\,B\,C\,K\,N$, is found by the expression

$$F = M - c \times (N - 1) \times (a - b).$$

For the present example,

$F = 6.4 - 0.03 \times (3.78 - 1) \times (18.1 - 10) = 5.7$ pounds per square inch.

If a steam engine could be designed so as to give a diagram similar to the theoretical figure under consideration, the result of the preceding calculation could be used in practice. But it is well known that the practical diagram seldom, if ever, coincides with the lines drawn by theory, and it is a good engine which will give as much as 95 per cent. of the theoretical pressure. Some further modifications of the theoretical diagram are explained in treating of the losses of heat, the object being to derive, at last, a theoretical diagram which shall agree fairly with practice.

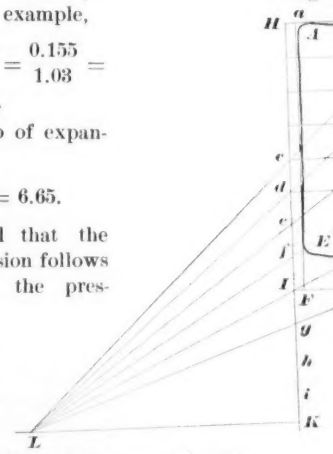


Fig. 2.

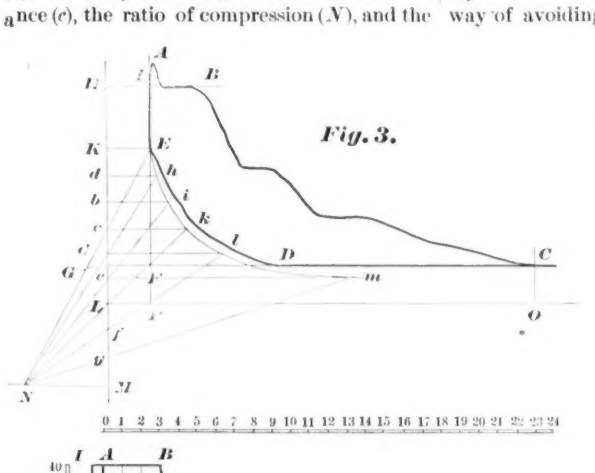


Fig. 3.

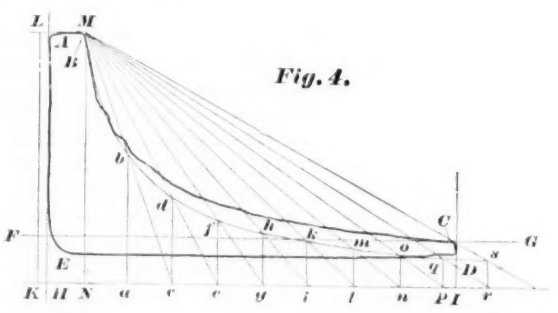


Fig. 4.

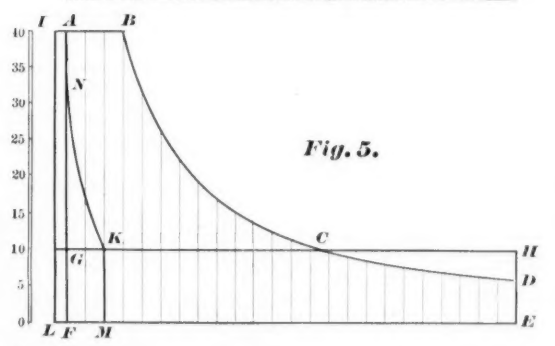


Fig. 5.

EXPANSION OF STEAM.—SEE PAGE 2.

Shop Notes.

BY JARNO.

No. 8.

GASCON SPEAKS.

I had called on Gascon to learn how he knew when he had taken the warp out of his planer.

Gascon said: "To-day I have not the time to show you."

"But, Gascon, here is a correspondent, J. B., of the AMERICAN MACHINIST, who would like to ask whether you did not act rather hastily in discharging a draftsman for calculating the strains in order to know how much iron to put into the crosshead of the planer you are making. J. B. thinks the draftsman knew about how much the belt would pull, and could, therefore, easily calculate the greatest strain on the crosshead."

"There it is again. The draftsman knew 'about' how much the belt would pull! Once more I say, if we base our calculations on 'about,' we as well might *about* the answer and omit the calculations. Even were I to make calculations to learn the sizes of my planer parts, I should start at the other end of problem. That is, the thing given in the question would be the size of the work that I expected to plane. The width of the belt would be in the answer, and not in the question.

"In machine tools I suppose a large factor of safety would be allowable. I have heard another name for this factor of safety—the factor of ignorance. From the number of boiler explosions, bridge breakings, and house tumblings that I hear of, I should say that somebody ought to study up some way of avoiding the factor of danger.

"When a man has a genius for calculating strains, I think that for him the field of a machine tool shop is too small. He is wanted by the bridge makers and house builders. It would be more for my interest to have him in the employ of my competitor Labrihed.

"But here comes Werner, one of my draftsmen that was not discharged. With him I will leave you to be entertained."

I asked Werner: "Are you a graduate of a scientific school?"

Werner answered: "I was graduated by one of the larger industrial universities, and for fourteen years have been a practical draftsman."

"What do you think about calculating strains to determine the sizes of parts of structures?"

"In designing bridges, buildings, cranes, it is best to make calculations as a help in determining the sizes of the parts. So far as I know, machine tool makers do not make these calculations. Tools in use, I have no doubt, would be found to have a higher factor of safety than most other structures. When designing machine tools, instead of going to the scientific text books, the custom is to go to the catalogues of other makers.

"Even in the manufacture of steam engines, I fear there are either too many or too few calculations. A professor in the Stevens Institute just told me of a pillow block that, wholly unmindful of ten as its factor of safety, very unexpectedly broke.

"If we look at the planer crossheads from a half dozen makers, we shall see no two of the crossheads that are alike, their only resemblance being that they are made for the same purpose. If calculations had been made, and if they led to similar results, we should see more resemblance, one to another, among the crossheads. The weakest planer crosshead I ever saw did not break."

Bidding me good morning, Werner stepped back into the drawing room. Werner appeared to be a man who says but little, and who always says less than he thinks. How far the expression of his opinion is modified by his working for Gascon I cannot state. His subdued manner contrasts strangely with the vigorous air of the impetuous Gascon.

And I went away without learning how Gascon tested his planer.

Moulding Small Castings.

BY S. BOLLAND.

There are many ways of moulding small work where large numbers of one kind are required. Ordinarily when one or two only are wanted of a casting, such as is seen in plan and section at Fig. 83, the pattern is placed along with others in a flask like the one shown at Fig. 85, taking care to joint down to the half of curve on the round edge, so that, after the impression of the top side has been taken in the cope or top part of flask, the pattern can be withdrawn, the gates to the various castings being cut with tools for the purpose. All this is proper where a different casting (or castings) are made in almost every flask, but such castings are in consequence very high in price, on account of the extra time required to make them. But when a large order of one kind of casting is given, a much better method may be adopted. A good method is shown at Figs. 84 and 85, being an illustration of the match-board system, and eminently suited for this kind of work. Let Fig. 84 be turned so that the cope side is at the bottom, and it will be more readily understood. As will be seen, the match-board takes the correct form of pattern up to the half of curve, as seen at *B*. The patterns—eight in number—are made fast to this board as seen in plan at Fig. 85, the gates also being attached to board, the intention being that when the board is lifted off all the patterns shall be drawn at once with the gates ready cut.

As this work is small, a snap flask will be all that is required to mould them. To accomplish this, let the match-board be large enough to pin on the flask, the pins being long, so as to reach through the board and into the upper half of flask, as seen at *A*, Fig. 86. Commence by setting the flask down with board between, ram the nowel and roll over on a rough board. (Let the engraving be now reversed, so as to have cope side on top.) Set in gate pin *C*, and ram the cope; after lifting off the cope, tap the corners of the match-board and draw off. Nothing remains now to be done but close the mould over eight washers, made in an incredibly short space of time.

Fig. 87 shows another kind of casting, which, if moulded in the ordinary way, there would be very slow progress made. A match-board in plan is shown at Fig. 88; ten patterns are arranged with gates attached. Should there be any difficulty in drawing these patterns with the match-board, they can be placed on the board loose and drawn from the sand separately. A section of such a mould is shown at Fig. 86. As will be seen, a flask is needed for such a job as this. The flask is shown, but though the pins are seen at the sides, it is intended that they shall be set in at the ends, as shown in plan, Fig. 88. Iron plates are of course secured to the edge of the flask through which the pin passes; these serve as a protection to the pin hole. See *A*, Fig. 88, and *B*, Fig. 86.

The simplicity of this arrangement is apparent, and will recommend itself to any firm which once in a while receives an order for a large number of castings of a kind similar to those described, but have made them in the ordinary way on account of the cost of getting up an elaborate system of match plates. The cost is trifling compared with the advantages gained, as very inferior men can readily turn off treble the quantity of work they have been accustomed to by the ordinary system.

A decision was recently rendered by Judge Colt in the U. S. Circuit Court at Boston, which is of interest to owners of patents and those who use patented machines, and involves the right of a purchaser to repair a patented machine in his possession. The defendants in this case claimed that they had a right to make and sell parts of a patented machine for the sole purpose of replacing parts which had been worn out. According to the decision, they have such right where the machine as an entirety is covered by a patent, the machine being composed of several separate and distinct parts, which are not separately patented. But if a patent is obtained for a distinct part or element of a machine, a purchaser will infringe by replacing that part.

Machine Designing.

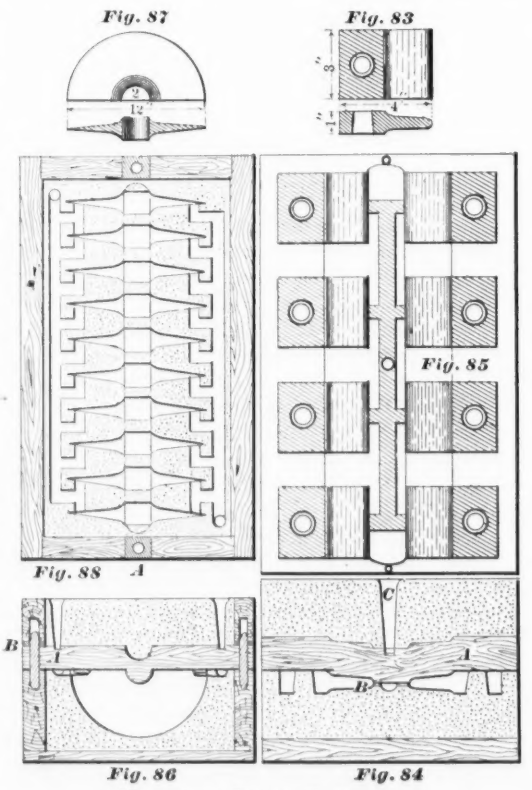
BY PROF. JOHN E. SWEET.

II.

An almost endless and likely profitless discussion has been indulged in as to the proper way to guide a slide-rest, and different opinions exist. It is a question that, so far as principle is concerned, there ought to be some way to settle which should not only govern the question in regard to the slide-rest of a lathe, but all slides that work against a torsional resistance, as it may be called—that is, a resistance that does not directly oppose the propelling power; in other words, in a lathe the cutting point of the tool is not in line with the lead screw or rack, and a twisting strain has to be resisted by the slides, whereas in an upright drill the sliding sleeve is directly over and in line with the drill, and subject to no side strain.

Does not the foregoing statement "that the propelling power should be as near the resistance as possible, and the guide be as near in line with the two as possible," embody the true principle? Neither of the two methods in common use meet this requirement to its fullest extent. The two-V New England plan seems like sending two men to do what one can do much better alone; and the inconsistency of guiding by the back edge of a flat bed is prominently shown by considering what the result would be if carried to an extreme. If a slide such as is used on a twenty-inch lathe were placed upon a bed or shears twenty feet wide, it would work badly, and that which is bad, when carried to an extreme, cannot well be less than half bad when carried half way.

The ease with which a cast-iron bar can be sprung is many times overlooked. There is another peculiarity about cast-iron, and likely other metals, which an exaggerated example renders more apparent than can be done by direct statement. Cast-iron, when subject to a bending strain, acts like a stiff spring, but when subject to compression it dents like a plastic substance. What I mean is this: If some plastic substance, say a thick coating of mud in the street, be leveled off true, and a board be laid upon it, it will fit, but if two heavy weights be placed on the ends, the center will be thrown up in the air, far away from the mud; so, too, will the same thing occur if a perfectly straight bar of cast-iron be placed on a perfectly straight planer bed—the two will fit, but when the ends of the bar are bolted down the center of the bar will be up to a surprising degree.



MOULDING SMALL CASTINGS.

And so with sliding surfaces when working on oil. If, to any extent elastic, they will, when unequally loaded, settle through the oil where the load exists and spring away where it is not.

The tool-post, or tool-holder, that permits of a tool being raised or lowered and turned around after the tool is set, without any sacrifice of absolute stability, will be better than one in which either one of these features is sacrificed. Handiness becomes the more desirable as the machines are smaller, but handiness is not to be despised even in a large machine, except where solidity is sacrificed to obtain it.

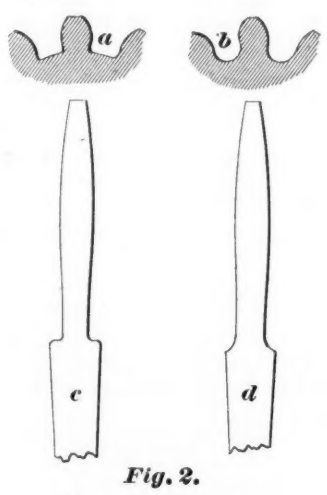


Fig. 2.

MACHINE DESIGNING.

The weak point in nearly all (and so nearly all that I feel pretty safe in saying all) small planing machines is their absolute weakness as regards their ability to resist torsional strain in the bed, and both torsional and bending strain in the table. Is it an uncommon thing to see the ways of a planer that has run any length of time cut? In fact, is it not a pretty difficult thing to find one that is not cut, and is this because they are overloaded? Not at all. Figure up at even fifty pounds to the square inch of wearing surface what any planer ought to carry, and you will find that it is not from overloading. Twist the bed upon the floor (and any of them will twist as easy as two bass-wood boards) and your table will rest the hardest on two corners.

Strap, or bolt, or wedge a casting upon the table, or tighten up a piece between a pair of centers eight or ten inches above the table, and bend the table to an extent only equal to the thickness of the film of oil between the surface of the ways, and the large wearing surface is reduced to two wearing points. In designing it should always be kept in mind, or, in fact, it is found many times to be the correct thing to do to consider the piece as a stiff spring, and the stiffer the better. The tooth of a gear wheel is a cast-iron spring, and if only treated as would be a spring, many less would be broken. A point in evidence:

The pinions in a train of rolls, which compel the two or more rolls to travel in unison, are necessarily about as small at the pitch line as the rolls themselves; they are subject to considerable strain and a terrible hammering by back-lash, and break with discouraging frequency, when made of cast-iron, if not of very coarse pitch, that is, with very few teeth—eleven or twelve sometimes.

In a certain case it became desirable to increase the number of teeth, when it was found that the breakages occurred about as the square root of their number, when the form was changed by cutting out at the root in this form (Fig. 2) the breakage ceased.

a, Fig. 2, shows an ordinary gear tooth and *b* the form as changed; *c* and *d* show the two forms of the same width, but increased to six times the length. If the two are considered as springs, it will be seen that *d* is much less likely to be broken by a blow or strain.

The remedy for the flimsy bed is the box section; the remedy for the flimsy planer table is the deep box section, and with this advantage, that the upper edge can be made to shelve over above the reversing dogs to the full width between the housings.

The parabolic form of housing is elegant in appearance, but theoretically right only when of uniform cross section. In some of the counterfeit sort the designers seem to have seen the original Sellers, remembering the form just well enough to have got the curve wrong end up, and knowing nothing of the principle have succeeded in building a housing that is absolutely weak and absolutely ugly, with just enough of the original left to show from where it was stolen. If the housing is constructed on the brace plan, should not the braces be straight, as in the old Bement, and the center line of strain pass through the center line of the brace? If the housing is to take the form of a curve, the section should be practically uniform, and the curve drawn by an artist. Many times housings are quite rigid enough in the direction of the travel of the table, but weak against side pressure. The hollow box section, with secure attachment to the bed and a deep cross beam at the top, are the remedies.

Raising and lowering crossheads, large and small, by two screws, is a slow and laborious job, and slow when done by power. Counter-weights just balancing the crosshead with metal straps rather than chains or ropes, large wheels with small anti-friction journals, and the crosshead guided by one post only, changes a slow to a quick arrangement, and a task to a comfort. Housings of the hollow box section furnish an excellent place for the counter-weights.

The moving head, which is not expected to move while under pressure, seems to have settled into one form, and when hooked over a square ledge at the top, a pretty satisfactory form, too. But in other machines built in the form of planing machines, in which the head is traversed while cutting, as is the case with the profiling machine, the planer-head form is not right; the propelling screw, or whatever gives the side motion, should be as low as possible, as should also be the guide.

There is a principle underlying the Sellers method of driving a planer table that may be utilized in many ways. The endurance goes far beyond any man's original expectations, and the explanation, very likely, lies in the fact that the point of contact is always changing. To apply the same principle to a common worm gear it is only necessary to use a worm in a plain spur gear, with the teeth cut at an angle the wrong way, and set the worm shaft at an angle double the amount rather than at 90°. Such a worm gear will, I fancy, outwear a dozen of the scientific sort. It would likely be found a convenience to have the head of a planing machine traverse by a handle or crank attached to itself, so it could be operated like the slide rest of a lathe, rather, than as is now the case, from the end of the crosshead. The principle should be to have things convenient, even at an additional cost. Anything more than a single motion to lock the crosshead to the housing or stanchions, should not be countenanced in small planers at least. Many of the inferior machines show marked improvements over the better sorts, so far as handiness goes, while there is nothing to hinder the handy from being good and the good handy.

When we consider that since the post-drilling machine first made its appearance, there have been added Blaisdell's quick return, the automatic feed, belt-driven spindles, back gears placed where they ought to be, with many minor improvements, it is not safe to assume that the end has been reached; and when we consider that as a piece of machine designing, considered in an artistic sense entirely, the Bement post drill is the finest the world ever saw (the Porter-Allen engine not excepted, which is saying a good deal), is it not strange that of all mechanical designs none other has taken on such outrageous forms as this?

One thing that would seem to be desirable

and that ordinary skill might devise, is some sort of snap clutch by which the main spindle could be stopped instantly by touching a trigger with the foot; many drills and accidents would be saved thereby. Of the many special devices I have seen for use on a drilling machine, one used by Mr. Lipe might be made of universal use. It is in the form of a bracket or knee adjustably attached to the post, which has in its upper surface a V into which round pieces of almost any size can be fastened, so that the drill will pass through it diametrically. It is not only useful in making holes through round bars, but straight through bosses and collars as well.

The radial drill has got so it points its nose in all directions but skyward, but whether in its best form is not certain. The handle of the belt shipper, in none that I have seen, follows around within reach of the drill as conveniently as one would like.

As the one suggestion I have to make in regard to the shaping machine best illustrates the subject of maintaining true wearing surfaces, I will leave it until I reach that part of my paper.

Perfect as are the modern boring machines, both horizontal and vertical (and the reason they average so good is probably because the imitators find no poor ones to copy), there is one thing that might in many cases be found valuable, and that is a rotary spindle driven at various speeds and fixed in a head movable along the cross beam of the vertical machine. This would be complete for boring the crank-pin hole in engine cranks, and a complete plain radial drilling machine, useful in all shops where the machine only has legitimate work enough to keep it employed for a part of the time. Such a machine could hardly be called a compound, and certainly not a combined machine, although used for turning, boring and drilling. Combined tools and machines are seldom successful. A common hammer, which may be said to have two business ends, a lathing hatchet, and a Disston's nigger saw, as I believe we used to call it down South, cover nearly the whole ground in tools, and Scott Russell's idea, as expressed in his remark, after viewing a combined machine at the Paris Exposition, may be remembered to advantage. The machine referred to consisted of a central post with a drilling machine on one side and a slotting machine on the other. After staring at it with evident curiosity, the attendant, somewhat elated at the apparent interest of his distinguished visitor, asked what he thought of it, to which he replied: "I was thinking if I had that machine which par I would cut off, the drill or the slotter?" What I know about a slotting machine is fairly comparable to Burton's knowledge of the French language. He said he knew the French language by sight, and that's about the extent of my knowledge of a slotter, and possibly this is the reason I could never persuade myself into the belief that they look well, or as well as it is possible to make them. The slotting machine, like others of the overhanging class, that is, drilling and punching machines, is subject to strains that they have to resist at a disadvantage, and where springing to a certain extent cannot be avoided. Might it not be set down as a principle that the framing should be devised so as to have the springing do the least possible harm? A slotting machine might be so designed that all the spring there was in the machine would have a direct tendency to throw the cut out of square with the table; whereas, if the sliding bar was worked with a walking-beam there would be no detrimental spring whatever. Evil resulting in a punching machine from springing is of another character altogether; much springing adds immensely to the power required to do the punching, and unless specially designed to avoid such a result, the springing throws the punch out of adjustment with the die, and bad work and dull tools are the result.

If the upper and lower parts of a punching machine are just equally rigid or equally elastic, and the punch and die central between the two, then the springing, however much, would not throw the tools out of register, and would do no harm except the waste of power. The loss of power in springing a machine is sometimes returned when the spring returns, but in a punching machine all power expended in springing the frame is a dead loss. The springing of machine framing, the springing of tools, and the work, all add to the cost of doing work, not only on account of a loss of power, but in the dulling of the cutters, and in this none more so than the milling machine. The tools or cutters themselves are costly, and the act of cutting, as performed by an ordinary slabbing cutter, differs from nearly all other cutting action. Each separate chip removed is a wedge-shape piece, and the cutting edge of the cutter starts in at the point of the wedge. The appearance of a milled surface, as ordinarily left on soft metal, is usually more uneven than any feed or imperfection in the cutter accounts for, and it is safe to assume that the teeth of the cutters slip over more or less and then bite and gouge in deeper than if each one took its allotted amount. Both actions tend to dull the cutters, and not only the spring of the machine and cutters tend to produce this result, but an elastic feed motion also contributes to this same result, so that a rigid feed is likely more essential in a milling machine than in any other.

Many have thought that as a remedy for the difficulties arising from the cause above described, that it would be an improvement to feed the work to the milling machine in the opposite direction, that is, so the cutting edges of the milling cutter would start in at the large end of the wedge; but whether this would be an advantage (except, perhaps, in cutting shapes) is doubtful. In the roughing cut the cutting edge would be starting in on the scale, and in finishing flat work the cut is so slight that there could be but little gain.

Milling machines were for years thought to be well adapted for small work, but not for large, and this idea is likely entertained by many yet, while others believe that the reason it has not proven successful in large work was because there were no large machines, while the truth probably is that the kind of work has more to do with the question of adaptability than the size, and that certain classes of work of whatever size can best be done by rotary cutters, while other kinds will always be best done by the planing, shaping and slotting machines.

What cutting action shall be adopted to perform a certain operation is as much a question in machine designing as any other. The most perfect of all machine work is done by an emery or corundum wheel, and the next, of all I have seen, is done with what is usually understood, though perhaps not properly, an end mill. Cutting tools, traversing in curved paths across a flat surface, have an advantage in never following over twice in exactly the same path, as is the case in a planer tool, which probably accounts for the absence of chatter; but, on the other hand, the cutting blade traverses over eleven inches of distance to finish a seven-inch cut. The planer wastes time in stopping, running back and starting, while the traversing blades are always at it.

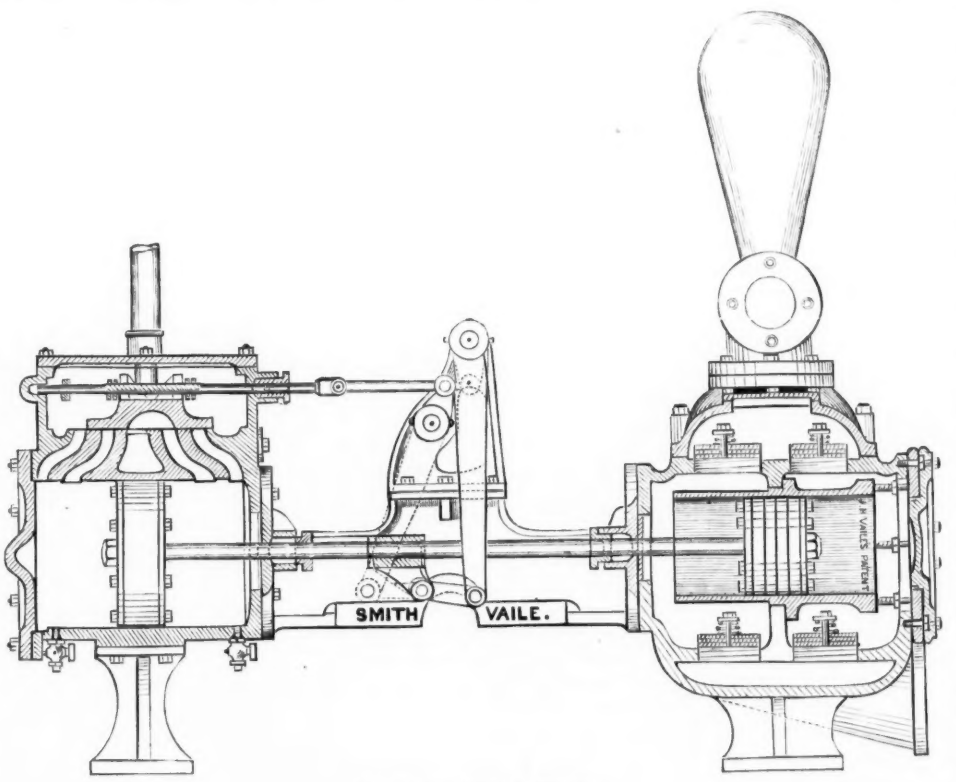
After a half century of study over the lathe and planer, improvement still goes on, and in this view what may we not expect a quarter of a century hence of the milling and traversing cutters and emery cutting devices?—Reprinted from the *Journal of the Franklin Institute*.

The *Jewelers' Journal* says:

While it is very common to hear the expression, "Trade is dull," upon pressing the inquiry, "How does it compare with last year?" the answer almost invariably has been, "It is as good," and some say, and we think truly, "Better than last year in January and February." In fact, the American people have, with their disposition to quick trading, encouraged by the rapid progress and development of our industries, become so habituated to large and profitable trade, that the supplying of legitimate regular marts does not satisfy them. They would like a continuous boom. We are really having a steady, good trade, with no savor of spurt or panic. Should we say the state of trade is of just about the same volume as last year, with collections not quite as free, we should probably fairly express the situation.

It has been found that brass tubes, when properly annealed and suspended in a vertical position from a point near the top, and struck at a point above the point of suspension, have resonant qualities far superior to bells, especially when comparative weight and cost are considered. This fact has been made the subject of a German patent, and tubes are being used there for chimes in church towers.

Walter H. Durfee, of Providence, R. I., who makes fine hall clocks, is making use of these tubes for chimes, which are rung by the clock movement at regular intervals, and while in his shop recently we saw some clocks in which surprising results were attained in point of purity, clearness and volume of tone, by their use. Some idea of the comparative efficiency of tubes for the purpose is obtained from the fact that a tube three inches diameter outside and one-half inch thick, twelve feet long, can be easily heard at a distance of one mile, and under favorable circumstances two or three miles.



IMPROVED STEAM PUMP.

An Improved Steam Pump.

We present with this a sectional view of a pump, the water end of which has a new feature in pump construction.

In the center of the cylinder and valve chamber a ring is cast, which is bored out and faced true with the center line of the pump, and on the outside of the water cylinder a flange is cast, which is turned and faced to fit the ring in the chamber. This feature is clearly shown in the cut. The outer end of the cylinder has a number of studs tapped into it, which, after the cylinder is in place, are screwed out against a ring, which is bolted onto the end of the chamber. The cylinder is thus securely held in place, and yet can readily be taken out, if for any reason it is desirable to do so.

The opening through the ring is large enough to allow of the pump piston being taken out through it if desired, and the head is bolted on over it.

It will readily be seen that this arrangement of the water cylinder has several advantages; an extra cylinder can be kept on hand, which can be substituted for the one in use at any time, and the change made without throwing the pump out of service more than half an hour in most cases, thus avoiding the long stoppages occasioned by the necessity for re-boring the cylinder. The proportion between the steam and water cylinders can at any time be readily changed when desired, since cylinders having different sized bores can readily be put into the same pump. This feature has been found valuable to railroads having a number of pumps at different stations along the line, working under various heads, because all parts can be kept interchangeable except this cylinder and the water piston, and changes to suit different positions and circumstances can be made with comparatively little trouble.

Cylinders made of, or lined with various materials may readily be put in, and they are furnished made of iron lined with brass, porcelain or vulcanized rubber, or they may be made entirely of any suitable material. Adjustable packing is used in the piston. The pumps are duplex, either simple or compound, and are built up to 5,000,000 gallons capacity for water-works, or small enough for boiler feeding.

The water valve seats are screwed into their places by a taper thread upon the outside, and the stems are secured to the valves in the same way, and prevented from turning by wires which pass through the stems and enter holes at each side of the chamber.

The other features of the pump are familiar, and will readily be understood from the engraving.

The builders are the Smith & Vaile Co., Dayton, Ohio, and 112 Liberty street, New York city.

The Engineer (London) occasionally makes a point against American "inventors," and the following is one of them:

They are apparently trying an old invention in an American rolling mill. The *American Manufacturer* says: "A public test took place at the Chester Rolling Mills here to-day of the new device for the saving of fuel and the improving of iron. The process is simply the spraying of fine coal, reduced by the cyclone pulverizer to a powder, into a chamber attached to the furnace, in which the combustion is so perfect that all the waste hitherto occurring in smoke and ashes is entirely obviated. The general result showed a saving of between 40 and 50 per cent. in coal, a saving of 50 per cent. in time of heating the furnace, and a greatly improved quality of iron."

The above is good. The man who remembers when the idea of burning pulverized fuel originated is, no doubt, so far as age goes, venerable. But if our contemporary could see exactly where the "cyclone pulverizer" comes in, it would, perhaps, have a better conception of the matter. The aforesaid pulverizer is a machine for pulverizing coal, which it no doubt does very effectively. And the item which our contemporary quotes was undoubtedly instigated to puff the pulverizer, and not the efficiency of the material operated upon.

LETTERS FROM PRACTICAL MEN.

Milling vs. Planing.

Editor American Machinist:

The first object of reading a paper like yours is information, and, judging others by myself, I suppose the discussions the most interesting part of it to your readers.

In your issue of April 14th, Mr. F. L. Johnson says he is alone on the planer side of the question. Well, Mr. J., I hereby place myself with you under the banner of the planer.

So far as my observation goes, I agree with your views perfectly. I have not, however, had a very long experience with a milling machine—no heavy ones at that—and do not remember having seen a cut made wider than about three or four inches solid; but so far as my observation goes, up to that width, a planer of equal value will do four times the surface with same depth of cut, and do it easier and cheaper as to tools, time of making ready, attendance, etc. It is useless to say we did not put the machine to the work. It was tested thoroughly by myself and others—all the belt would carry on the various speeds and feeds, even so far as to pull the teeth out of the cutter. We were told the cutters could be run as high as 90 feet a minute, but the best we could do was about 75, and about 40 to 45 was better, on wrought-iron.

There were jobs which could not be satisfactorily done on the milling machine. Take, for instance, a stub end with the strap keyed on. If the end of the rod was milled first, as soon as the cutter came to the two edges of the strap it would cut very perceptibly deeper. If the strap was milled first, cutter would lift when it came to the end of the rod, no matter how light the cut in either case. Even cutting over the side of a strap the cut would be deeper in passing the key-slot, making a good deal of extra filing to finish. Our machine is of the most approved make, of good weight and size, in splendid order, and, being expensive, is taken good care of.

In milling gibs and keys, the last cut, unless very light, always bends them, so that if milled up near the size they will finish too small, and although they appear very smooth, will take as much filing as if planed.

Cheap attendance may pay in a manufactory, but I have not been able to see it economical with us. The cutters are expensive, and easily broken, and it is not a boy's job to grind them properly. A milling machine is a good tool in any shop, but if we cannot have but one, we will take the planer.

CENTER PUNCH.

Editor American Machinist:

Having read the articles Milling *vs.* Planing that have lately appeared in your valuable paper, I would say that in my twenty years' experience on planers, doing both light and heavy work, I have always found that planers, with a well-paid man to run them, are more than a match for the milling machines under the same conditions on all ordinary work, taken as a whole, from sewing machines to engines, presses, etc. How is it that in many shops you find the milling machines doing nothing but collecting dust for a good part of the time, and the planers with all they can do on work that would come under the scope of work adapted for the milling machines.

Cases have come under my observation in a few shops where they have discarded milling machines and replaced them with planers because the planers would do more work, better and cheaper. Now in regard to the assertion of one correspondent, viz., that he had given up hopes of ever getting a planer hand to put on more than one tooth on the down feed. Having had charge in a few shops, I will, in justice to the planer hands, say that I never had to urge a well-paid man to put on more down feed. But I have had trouble in that line with cheap planer hands and boys. I will here further say to your correspondent, who had that remarkable test made between a $2.50 planer hand and a boy on milling machines, that if he will furnish me with a number of pieces, the more the better, I will guarantee to make $3.00 per day, hire the tools, and give him a bonus, at the same price per piece that they cost him on the milling machine—conditions in all respects being the same.

In regard to planing with templets, I have planed reversing links with them, and many other similar pieces of work.

I hope you will excuse me for intruding, as this is my first offense in any newspaper controversy. J. E. KIRK.

Middletown, Conn.

Editor American Machinist:

In your issue of April 14, Mr. Johnson, in an article headed "Milling Machine against Planer," makes some remarkable statements, which show that he has not had so much experience with a milling machine as he might have.

He has rigged up a pair of centers to a lathe bed, and calls it a milling machine, with a feed that is ordinary and a return motion, which, according to his own figures, takes half as long to make the return on a four-inch cut as to make the cut itself.

This does not work to suit him (and no wonder), so he rigs up his shaper (which he seems to be an expert at handling), to do the same work, with a feed which is the most extraordinary thing, even if you allow no time for the return of the head, that I, or any one else whom I know, ever heard of. He fed his cutter and the work in his milling machine so as to make a cut 5″ long, $\frac{3}{16}$ deep in a minute, and his tool in the shaper so as to make a cut 5″ long, $\frac{3}{16}$″ deep in one-half minute.

Now if this was done, it simply proves that the feed on his milling machine was about half as fast as it should have been. There is no reason why a cutter with twelve teeth in it, in a properly constructed machine, running more feet per minute, could not be fed just as fast as a single tool with only one cutting edge.

It would take an ordinary man five minutes, at least, to make the cut he speaks of and keep his tool in good enough condition to go ahead with the work at all economically.

As he seems to have used a lathe for a milling machine, it is just possible that he has not a correct idea of how long it would take a man running a good milling machine, to get it ready for work. Of course, I know there are some machines on the market which it takes almost as long to rig up as it does to file the work out, but they are the exceptions. In our shop an ordinary job can be half done on a milling machine before the planer hand can get the burrs off his parallel strips, his vise squared up and his soap water ready to go ahead. E. M. CHACE.

Steam Heating Difficulty Overcome.

Editor American Machinist:

In your issue of the 14th inst. I notice a question (No. 198) from U. S. U., Springfield, Mass., in reference to heating a house. Having had a similar difficulty a few years ago, I think the plan I adopted will help him. Having had a gravitation system of steam heating in my house for some time, I wished to introduce steam from another boiler 350 feet distant, to use week days, while factory was running, and still retain the gravity system for Sundays or a breakdown that might occur at the factory. Steam was led to house at a pressure of from 60 to 80 pounds, into a drum about 6 feet long and 15 inches diameter. From the top of this the main steam pipe was taken, in which was a reducing valve, reducing the pressure to 5 or 6 pounds.

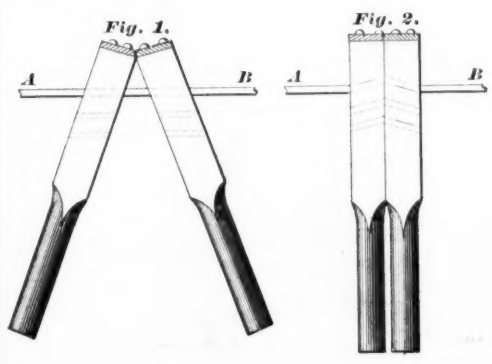
Wishing to keep the water level in the boiler, also to seal the returns, I attached an expansion trap at the required level, to one of the return mains. The result was, when the trap would discharge it would make a noise through the whole system, and would also continue its discharge until the whole system was drained and the steam admitted to the returns, thus stopping the circulation. The plan adopted was to hold the water in the boiler by the stop valves in steam and return pipes, place the trap at the lowest point in the returns; and put check valves on the return pipes from each radiator, so as to prevent back pressure. This plan overcame all the difficulty, and has worked to perfection for the last two years.

Having often got useful hints from the AMERICAN MACHINIST, I felt that if my experience would be of any service to your correspondent he should have it. Of course I don't know that his case is the same, but presume his boilers are used to seal the returns only. JOHN FISHER.

A Wire Straightener—Soldering.

Editor American Machinist:

I am greatly in debt to your valuable paper for many hints, and as a partial payment I send the following kink. It is not original with me. An old gentleman in Bangor, Me., who had a little tinker shop in which he amused himself by getting up small patents in harness hardware, etc., first showed it to me. I fail to recall his name, but remember the quiet chuckle with which he straightened a very crooked piece of short wire in considerably less than a minute, on his foot lathe. He had two pieces of hard wood an inch square and a foot long, hinged together at one end by a piece of belt tacked on with brads. In these he had drilled holes a little larger than his wire, and at an angle as shown in Fig. 1. Securing the end *A* of the wire in his lathe chuck, he slipped his pieces of wood on over the wire and up to the chuck. Starting up his lathe at its fastest speed and closing the two pieces of wood as in Fig. 2, he drew them slowly to the right and off the end of the wire at *B*. Result—A piece of wire as "straight as a string."



WIRE STRAIGHTENER.

Care must be taken of the unsecured end *B* while running, as it is apt to break loose and rap the operator over the knuckles in a way that will make him exceedingly tired.

The tail stock of the lathe can be brought up with the center removed and the end *B* inserted in its place, which will give it steadiness.

I have used this device for straightening spokes for bicycles after they were cut off and threaded, and it worked to a charm. Modifications of this tool in metal will readily suggest themselves.

To solder two flat surfaces together—a job frequently necessary in tool making—take the tin foil off tobacco packages (you can readily find it in most machine shops) and lay one thickness between the surfaces, previously wetting them with acid; clamp them tightly and heat until tin foil melts. The strength of the joint will surprise one who has never tried it. W. R. MACDONALD.

Truing Up the Main Journal of a Steam Engine.

Editor American Machinist:

It is very interesting to read the many ingenious expedients of mechanics when they have to rely entirely on their own resources to overcome some difficulty that might seem at first as big as a mountain. The stimulus of the occasion, however, seems to bring out the contrivance. There are many who read these happy thoughts in exigencies who might chip in a little themselves. It would not do them any harm if they would draw something from their sinking fund of information, for the public good. With most, this proves quite a task. It is much more agreeable to read or criticise. It is nothing, though, to the task they have sometimes laid out for them, and they have to get through with it some way.

This brings me to relate an experience I had in a quartz mill out West. I was put in charge of the machinery, and found things in a bad way. The thumping of the engine could be heard over the noise of the stamps, quite a distance from the mill. The economical treatment of the ore requires the constant running of the machinery for a month or more at a time; then they will shut down for a day or two to do some necessary repairs.

I found among other evils that the journal of crank-shaft in the pillow-block was worn oval—the greatest and least diameters varying about a tenth of an inch. I was told that it had been roughed up by heating, and they tried to hand-tool it smooth, while running.

Nearly every man about the place could run an engine, and every one who had a chance had left his mark. To strip and send the shaft to the nearest machine shop over the mountains would be very expensive, besides the delay. That was what the management proposed to do. I thought it could be fixed right there. After some hesitation the superintendent allowed me to go ahead.

The engine was a 50 horse-power Frazer & Chalmers, having crank-pin set in a disk. I disconnected the shaft at the nearest coupling, and raised it a little out of the pillow-block. The second journal was not "out" appreciably, so I wedged the box up till the shaft was level.

I laid a 6×8 timber under the disk with a small space hollowed out, into which I ran some babbitt metal with the disk in place. This gave an easy bearing. Two timbers bolted to the engine bed, with their ends against the circumference of the disk, made that end secure. The quarter boxes were removed. For a slide rest, the only thing available was a bar of inch-square iron. One piece I dovetailed to match the other. The base fitting endways in the space of quarter box, a small tool was wedged into a recess cut near the end of slide. The base was shaped down from cap bolts. Two men walking on the fly-wheel gave motion to the shaft. A board was fixed in front of each, by which he could steady himself. One of them said it put him in mind of old times when he had to walk a treadmill in an English prison. I fed the slide along with a lever—took off a rough and a finishing chip, leaving it smooth and true. Then I lined up the parts, re-babbitted the boxes, and had the satisfaction of seeing the engine start off as smoothly as could be desired.

I think it took three and a half days to do the job. There was a forge, and some scraps of files to maneuver with. J. M.

Practical Drawing.

BY J. G. A. MEYER.

FORTY-NINTH PAPER.

PROBLEM 63.

433. *To find the true form of the curves of intersection made by passing a plane through a cylinder.*

Let $e_4\ e_5\ d_4\ d_5$, Fig. 327, page 7, represent the vertical projection of a given cylinder, and let the cutting plane be represented by the line $e_4\ n_4$; also *A B* the ground line. It is required to find the true form of the curves in which the cutting plane intersects the cylindrical surface.

In Fig. 327 the cutting plane is shown as standing perpendicular to the vertical plane of projection, and therefore it is represented only by one straight line, $e_4\ n_4$; in fact, when any cutting plane stands perpendicular to the vertical plane of projection, we can only see, so to speak, its edge. If the cutting plane is limited in size, and does not stand perpendicular to the vertical plane of projection, it must be represented by more than one line, either straight or curved, as the case may require. Thus, for instance, let the cutting plane be limited by the lines in which it intersects the cylindrical surface, and also, by the bases of the cylinder. Now suppose the cutting plane does not stand per-

pendicular to the vertical plane of projection, then the vertical projection of the cylinder will appear as shown in Fig. 330, in which the curves $c_4\ n_4$, $f_4\ s_3$, and the straight lines $f_4\ c_4$, and $s_3\ n_4$, represent the limits of the cutting plane. Here we see that because our cutting plane, limited in size, does not stand perpendicular to the vertical plane of projection, it is represented in the vertical projection by four lines; two of these are curved and two are straight lines.

The purpose of these remarks is simply to draw the reader's attention to the fact that when the cutting plane in the vertical projection is represented by only one line, we may feel reasonably sure that the drawing indicates the cutting plane to be standing perpendicular to the vertical plane of projection; of course to be quite certain we must have, in addition to the vertical, the horizontal projection of the cylinder.

Prolong the center line $a_4\ a_5$, Fig. 327, below the ground line $A\ B$, and from a point o_2 on this line, at a convenient distance below $A\ B$, draw the circle $a_2\ b_2\ c_2\ d_2$, whose diameter is equal to $c_4\ d_4$ or $c_5\ d_5$ in Fig. 327. This circle represents the horizontal projection of the cylinder. Through the center o_2 draw the diameter $c_2\ d_2$ parallel to the ground line $A\ B$. Now, since the cutting plane stands perpendicular to the vertical plane of projection, it must cut the lower and upper base of the cylinder in straight lines perpendicular to the ground line; therefore, through e_4 (Fig. 327) draw a vertical line cutting the circumference $a_2\ b_2\ c_2\ d_2$ in the points e_2 and f_2; the line $e_2\ f_2$ will be the horizontal projection of the line in which the cutting plane intersects the upper base of the cylinder; the point e_4 is the vertical projection of the same line. Through n_4 draw a vertical line, cutting the circumference $a_2\ b_2\ c_2\ d_2$ in the points n_2 and p_2; the line $n_2\ p_2$ is the horizontal projection of the line in which the cutting plane intersects the lower base of the cylinder. Let us now assume, for the sake of clearness, that the portion ($e_4\ d_4\ n_4\ d_5$, $e_2\ f_2\ d_2\ n_2\ p_2$) of the cylinder separated by the cutting plane is removed. Then the shaded part in Fig. 328 will represent the straight surface of the remaining portion of the cylinder, made by passing through the cylinder the cutting plane. Here we see plainly that the straight surface is bounded by the straight lines $e_2\ f_2$ and $n_2\ p_2$, and also by the arcs $e_2\ n_2$ and $f_2\ p_2$. The arc $e_2\ n_2$ is the horizontal projection of one of the lines in which the cutting plane intersects the cylindrical surface, and the straight line $e_4\ n_4$ in Fig. 327 represents the vertical projection of the same line of intersection. The arc $f_2\ p_2$ is the horizontal projection of the other curve in which the cutting plane intersects the cylindrical surface, and this same curve of intersection coincides in the vertical projection with, and is hidden by, the line $e_4\ n_4$.

Divide the line $e_4\ n_4$ into any number of equal parts, say three, and let $h_4\ k_4$ be the points of division. Through the point h_4 draw a vertical line cutting the circumference $a_2\ b_2\ c_2\ d_2$ in the points h_2 and i_2. Again, through the point k_4 draw a vertical line cutting the circumference $a_2\ b_2\ c_2\ d_2$ in the points $k_2\ l_2$.

Through the points $e_4\ h_4\ k_4\ n_4$ (Fig. 327) draw lines $e_4\ e_3$, $h_4\ h_3$, etc., perpendicular to $e_4\ n_4$ (do this with the aid of set square and T square, as shown in Fig. 71). On the line $e_4\ e_3$ lay off a point g_6; the distance between e_4 and g_6 should be equal to the distance between the points g_2 and the ground line $A\ B$ (Fig. 328); through the point g_6 draw a line $g_6\ r_6$* parallel to $e_4\ n_4$, and cutting the lines parallel to $e_4\ e_3$ in the points $i_6\ m_6\ r_6$. From the point g_6 as a center, and with a radius equal to $g_2\ e_2$ (Fig. 328) describe two short arcs cutting the line $e_4\ e_3$ in the points f_3 and e_3; from the point j_6 as a center, and with radius equal to $j_2\ h_2$, describe two short arcs cutting the line $h_4\ h_3$ in the points i_3 and h_3; again, from the point m_6 as a center, and with a radius equal to $m_2\ k_2$, describe two arcs cutting the line $k_4\ k_3$ in the points l_3, k_3; and lastly, from the point r_6 as a center, and with a radius equal to $r_2\ n_2$, describe two short arcs cutting the line $n_4\ n_3$ in the points p_3 and n_3. Join the f_3, i_3, l_3, p_3 by a curved line; also join the points e_3, h_3, k_3, n_3 by a curved line; these curved lines will be the true form of the lines of intersection.

444. Now let us examine the principles upon which this construction is based.

It has already been stated that the arcs $e_2\ n_2$ and $f_2\ p_2$ in Fig. 328 are the horizontal projections of the curves in which the cutting plane intersects the cylindrical surface, and limit in one direction the straight surface (which is formed by passing the cutting plane through the cylinder) in our cylindrical solid.

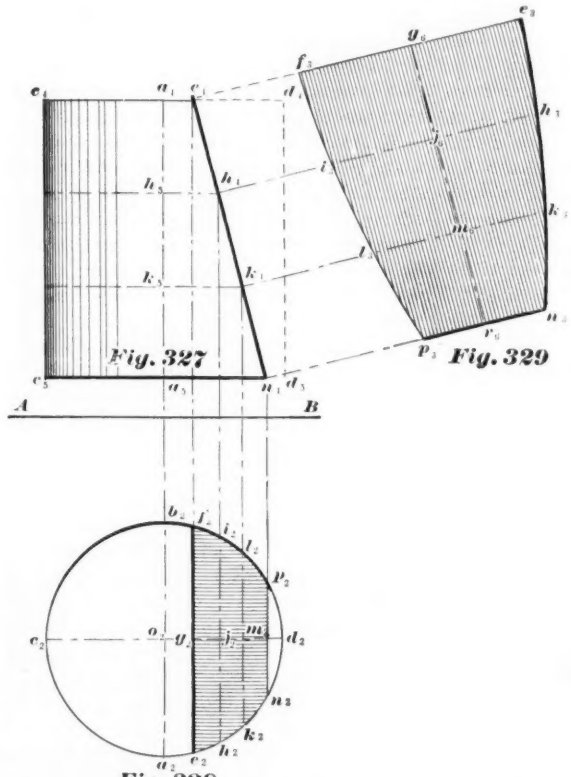


Fig. 328

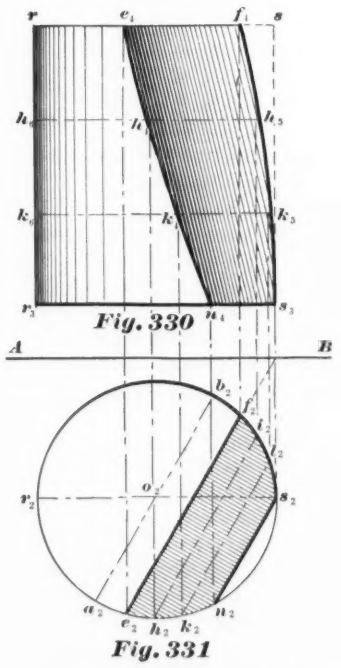


Fig. 330

Fig. 331

Now, suppose that through the points (h_4, h_2) (k_4, k_2) lines are drawn on the straight surface ($e_4\ n_4$, $e_2\ f_2\ n_2\ p_2$) and let the lines be so drawn that they are parallel to the horizontal plane of projection. These lines must be perpendicular to the vertical plane of projection, because they are parallel to the horizontal plane of projection, and lie in the cutting plane, which is perpendicular to the vertical plane of projection, and therefore the vertical projection of these lines will simply be the points h_4, k_4, and the horizontal projection of the same lines will be the lines $h_2\ i_2$, $k_2\ l_2$ (see Art. 239). The lengths of the lines $h_2\ i_2$, and $k_2\ l_2$ are limited by the arcs $e_2\ n_2$ and $f_2\ p_2$. Again, because the lines $h_2\ i_2$ and $k_2\ l_2$ are parallel to the horizontal plane of projection, we can see their correct lengths (see Art. 242), or, in other words, the line $h_2\ i_2$ shows the correct distance between the point h_2 in the arc $e_2\ n_2$ and the point i_2 in the opposite arc $f_2\ p_2$, both points h_2 (in one curve) and i_2 (in the other curve) lying in a line parallel to the horizontal plane of projection.

From this we conclude that at a given distance from the upper base, the line $h_2\ i_2$ represents the correct width of the straight surface $e_2\ f_2\ n_2\ p_2$ in the cylinder. The same remarks apply to the lines $e_2 f_2$, $k_2\ l_2$ and $n_2\ p_2$, and lead to the correct conclusion that these lines represent the correct width of the straight surface $e_2\ f_2\ n_2\ p_2$ at different heights above the horizontal plane of projection. Once more, in Fig. 328, the distances between lines $e_2 f_2$, $h_2\ i_2$, $k_2\ l_2$, $n_2\ p_2$ are shown foreshortened, and consequently the correct distances between these lines cannot be seen. In order to find these correct distances we must turn our attention to Fig. 327. The straight surface represented by the line $e_4\ n_4$ is part of, or lies in, the cutting plane, and since the cutting plane is perpendicular to the vertical plane of projection, the line $e_4\ n_4$ also represents the trace of the cutting plane. Now let us revolve the cutting plane around its trace $e_4\ n_4$ until it coincides with the vertical plane of projection. In doing so, the points e_4, h_4, k_4, n_4 will move in planes represented by the lines $e_4 e_3$, $h_4\ h_3$, $k_4\ k_3$, $n_4\ n_3$ drawn perpendicular to $e_4\ n_4$; it will also be readily conceived that the lines on the straight surface of our cylinder supposed to be drawn through the points h_4, k_4 perpendicular to the vertical plane of projection must fall in the lines $h_4\ h_3$ and $k_4\ k_3$ after the cutting plane has been revolved, also the lines through h_4 and n_4, in which the cutting plane intersects the bases of the cylinder must fall in the lines $e_4\ e_3$ and $n_4\ n_3$. Now, since Fig. 329 represents the cutting plane coinciding with the vertical plane of projection, we can see the correct lengths and forms of all lines on this plane, and also the correct distances between them. Hence in Fig. 329 the lines $f_3\ e_3$, $i_3\ h_3$, etc., represent the lines $f_2\ e_2$, $i_2\ h_2$, etc., in Fig. 328, the distances $q_6\ j_6$, $j_6\ m_6$, etc., represent the correct distances between these lines, consequently $g_6\ r_6$ will represent the correct length of the straight surface in the cylinder; and $f_3\ i_3\ l_3\ p_3$, $e_3\ h_3\ k_3\ n_3$, the correct or true form of the lines of intersection.

445. *Recapitulation.*—From the foregoing it should be readily perceived that in this construction we have used auxiliary lines $h_2\ i_2$, $k_2\ l_2$, Fig. 328; these lines are supposed to be drawn on the straight surface in the cylinder formed by passing a cutting plane through it. Auxiliary lines should always be drawn or assumed to be drawn parallel to either the horizontal or vertical plane of projection, so that their true lengths can at once be seen; in our problem they are drawn parallel to the horizontal plane of projection. The lengths of the auxiliary lines here used are limited by the curves of intersection. In Fig. 329 the auxiliary lines are placed at their correct distances apart, the curves which join the extremities of these lines, and also extremities of the lines $f_3\ e_3$, $p_3\ n_3$, which represent the lines of intersection of the bases of the cylinder and the cutting plane, will be the true form of the curves in which the cutting plane intersects the cylindrical surface.

446. It is of the greatest importance that the student should make himself thoroughly familiar with this construction and the method adopted for finding the curves of intersection, because this method is often applied to many important and interesting solutions of practical problems, as will presently be seen.

Directions.—In the space marked Prob. 63 draw the vertical and horizontal projection of a cylinder seven inches in diameter and eight inches high. Through this cylinder assume a cutting plane to be passed, which is represented by the line $e_4\ n_4$, in Fig. 327. The extremity e_4 is to be one inch from a_4, and the extremity n_4 is to be three inches from a_4. Then find the true form of the curves of intersection, as shown in Fig. 329. Use a three inch scale.

447. The student will obtain very good practice, and also will be aided in becoming familiar with the foregoing methods, by making a vertical projection of the cylinder with the cutting plane not perpendicular to the vertical or horizontal plane of projection. Hence the following problem.

PROBLEM 64.

448. *To find the vertical projection of the same cylinder shown in Fig. 327, but with the cutting plane making an angle of 60 degrees with the vertical plane of projection.*

Let $r\ s\ r_3\ s_3$, Fig. 330, represent the vertical, and $a_2\ r_2\ b_2\ s_2$, Fig. 331, the horizontal projection of a cylinder; it is required to find the vertical projection of the curves of intersection of the cylindrical surface and a given plane. The plane, that is, the cutting plane, is to be the same distance from the axis of the cylinder as that shown in Fig. 327, and is to make an angle of 60 degrees with the vertical plane of projection.

Let $A\ B$ be the ground line.

Draw the diameter $a_2\ b_2$ (Fig. 331) so that when it is prolonged towards the ground line it will make an angle of 60 degrees with the line $A\ B$. Parallel to $a_2\ b_2$ draw the line $e_2\ f_2$, making the distance between $a_2\ b_2$ and $e_2 f_2$ equal to that between the lines $a_2\ b_2$ and $e_2\ f_2$ in Fig. 328. Also draw the line $n_2\ s_2$ parallel to $a_2\ b_2$, making the distance between these lines equal to that between the lines $a_2\ b_2$ and $n_2\ p_2$, in Fig. 328. Divide the distance between $e_2\ f_2$, $n_2\ s_2$, in Fig. 331, into any number of equal parts, say three; and through the points of division draw the lines $h_2\ i_2$, $k_2\ l_2$ parallel to $e_2\ f_2$, terminating in the circumference of the circle. Divide the line $r\ r_3$, that is, the height of the cylinder (Fig. 330) into the same number of parts, namely three, and through the points of division h_6, k_6 draw horizontal lines.

Through the point e_3 draw a vertical line, cutting the upper base $r\ s$ in the point e_4; through h_2 draw a vertical line cutting $h_6\ h_5$ in the point h_4, through k_2 draw a vertical line cutting $k_6\ k_5$ in the point k_4, and through n_2 draw a vertical line cutting the lower base $r_3\ s_3$ in the point n_4. Join the points e_4, h_4, k_4 and n_4 by a curve, which will be the vertical projection of one of the lines in which the cutting plane intersects the cylindrical surface. Through the points f_2, i_2, l_2 and s_2 draw vertical lines cutting the horizontal lines (Fig. 330) in the points f_4, h_5, k_5 and s_4 respectively; join these points by a curve; this curve will be the vertical projection of other line in which the cutting plane intersects the cylindrical surface. The arc $e_2\ n_2$ will be the horizontal projection of the curve $e_4\ h_4\ k_4\ n_4$ and the arc $f_2\ s_2$ will be the horizontal projection of the curve $f_4\ h_5\ k_5\ s_3$.

Here it will be seen that in order to obtain the vertical projection of the curves of intersection, we again employ auxiliary lines; in fact the construction is similar to that in Problem 63. And the reasoning applicable to the construction in Figs. 327, 329, is also applicable to the construction in Fig. 330. Hence if the previous problem has been studied and understood, our present problem will also be understood without any further explanation.

Direction.—In space marked 64 find the vertical projection of the cylinder with the cutting plane, making an angle of 60 degrees with the vertical plane of projection. The dimensions of cylinder and position of cutting plane from the axis of the cylinder to be the same as shown in Fig. 327. Use a 3 inch scale.

In our next paper we will apply the same principles, here employed, to the solution of practical problems.

* For the purpose of simply determining the curves $f_3\ i_3\ l_3\ p_3$ and $e_3\ h^3\ k^3\ n_3$ it is not necessary to place the line $g_6\ r_6$ at any particular distance from the line $e_4\ n_4$; it may be placed in any convenient position. But since in our illustrations we have shown the ground line $A\ B$, it is proper to make the distance between the lines $e_4\ n_4$ and $g_6\ r_6$ equal to that between the ground line $A\ B$ and the line $c_2\ d_2$ in Fig. 328, so that the relative positions of the different views will agree with the principles enunciated.

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NEW YORK, MAY 5, 1888.

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Milling vs. Planing.

We publish elsewhere in this issue several communications in which our friends express their views upon the planing and milling machine question, and we have received a number of others upon the same question, which we appreciate, though we do not publish them, for lack of space, and because the points touched upon seem to be pretty well covered by those which have appeared.

There is a contest at present going on between planing and milling machines, not only in this paper, but in the shops, where, of course, it must eventually be settled.

It is not a war of extermination, however; for without doubt there is a field for the milling machine, and there is also a field for the planer, each being better adapted to the work in its particular field than the other.

The comparative efficiency of milling machines and planers depends not only upon the character of the work, but upon how much of it is to be done, the limit of variation allowable, and last, but by no means least, upon the man who is to manage them.

Because a planer may be more efficient than a milling machine in a given shop, under certain conditions, and with certain management, is no positive proof that it will be so in every shop or under other conditions or management, any more than because (as one of our correspondents says) a feed of $\frac{1}{64}''$ is fine enough for cutting key-ways, $1\frac{1}{2}''$ wide, on a 48" Sellers planer, therefore it is fine enough for any work on any size planer.

In some few machine shops it would probably pay to use milling machines entirely in place of planers, and there are other shops in which it would not pay to use them at all, but in the vast majority of shops, under intelligent management, it will pay to use both, each for its own appropriate work. This is not a mere theory, but is proven by actual shop experience. It is undoubtedly true, however, that the field which can profitably be covered by the milling machine is much more varied and extensive than has been generally believed, especially by those mechanics who have had only a very limited experience with them.

As tending to show the weight which the character of the work to be done must have in the choice of methods, we may mention a case coming under our observation. There were a lot of cold-rolled shafts about two feet long and two inches in diameter which were to have a half round groove cut in them from end to end, the groove being about $\frac{3}{16}$ inch wide and half as deep. Now if these grooves had been required to be very accurate as to dimensions and form, and to be left smooth and in good shape, it would have been a job after the milling machine man's own heart, but this groove was only for an oil way, and the job was being done on a planer. The man had a sort of fork bolted in the middle of the planer bed over the T-slot, into which the ends of the shafts were pushed after being laid in the slot, and they were not fastened down in any way. The shaft passed under the tool once and the groove was finished, and while it was doing this, the man picked up another shaft and laid it on the planer bed beside the first one; during the back stroke the shaft which had just been grooved was rolled out of the slot and the other one rolled in, and at every stroke of the planer a shaft was grooved, the planer not being stopped at all. The rate was about five shafts per minute, and the temptation to rig up a milling machine for the job was quite small, even for the most enthusiastic milling machine man. Of course the man who was running that planer was not a mechanic, and could not have done a fine job of planer work at all, but he was doing that particular job well enough for the purpose, and incidentally was demonstrating that for some work the planer was superior to the milling machine; but the same shop made use of many milling machines, and had that groove been of a different character it would have been milled, and milled better and faster than it could possibly have been planed.

Many such cases might be mentioned, going to show that the choice of a machine to do a certain job must be governed by the character of the job, and the decision should be made by a mechanic thoroughly familiar with both machines, and without prejudice for or against either of them.

Industrial Insurance.

The collapse of a so-called industrial insurance company in Ohio recently, is not without its lesson to the workingmen of the country, who just now are being importuned by agents for all sorts of life and accident insurance companies, associations, etc., without end.

It appears that the genius who originated this particular company succeeded in getting the names of some prominent and well-known business men interested in it, and their names of course appeared in the pamphlets, etc., to give the thing tone and inspire confidence, and yet when the end came it was discovered that the so-called company had never been chartered as the laws provide, and had thus escaped compliance with the laws regulating insurance companies, and all interference by the State Commissioner of Insurance.

While some of the insurance companies making a specialty of what they call industrial insurance may be all right, we should advise our readers to go to some trouble to assure themselves as to the standing of all such companies, and the soundness of their methods, before investing in any insurance with them.

Life insurance has a certain definite value, and when it is offered below that value there is something about it which is wrong. Gold dollars which are offered for fifty cents should be critically examined before purchasing.

It is well to remember that it is just possible that an insurance company which does not offer its policies to bankers, and business and professional men, is doing a business which will not bear the close and searching investigation which such men are in the habit of giving to such matters before going into them, and which most shop men have neither the time nor disposition to make for themselves,

Of course we do not pretend to say that good insurance cannot be furnished at considerably lower rates than are sometimes charged for it, but it is always advisable to thoroughly investigate the methods by which it is done, and see that they are based upon sound business principles.

A Contest of Mechanicians.

The prosecution of war has settled down to a contest of mechanicians. Hereafter personal bravery and strategy will play a second part in warfare, and mere numbers will count less than ever before. The nation whose mechanicians furnish the best guns and equipments of war, and make impenetrable vessels and forts, will win the battles. Even peace is an expensive luxury in these times, when the earnings of the multitude must be spent to keep up the semblance of an invincible front. But after all it is better that the mechanicians of the world shall settle battles. There is sure to be fewer battles, because the chances of success can be better weighed beforehand. And in the processes of building war ships, armored forts and guns, there is a possibility of learning something useful, and of general application. Let the mechanician come to the front, by all means. It is better that the contest be one of mechanical skill than one of mere weight of numbers. It is better in every way to spend money in preventing than in prosecuting war.

Secretary Whitney has addressed a note to Admiral Gherardi, of the Brooklyn navy yard, in which he reminds him that he, as commandant, will have placed in his charge the construction of the cruiser *Maine*, and that the people of the country will, in a sense, consider him as in competition with private yards. This is an excellent move. Our navy yards have been held up to derision by every one in the country of any authority to speak upon such subjects, as models of antiquated methods, and instructive examples of putting in force the principles of how not to do anything in particular. This is a good opportunity to refute these charges, and the first one that has happened in fifteen years, during which time the navy yards of the United States have been ornamental (with an interrogation point), rather than useful. If the *Maine* is built as cheaply as if made at a private yard, the press of the country will owe the navy department an apology.

The Nashville Meeting of Mechanical Engineers.

It is to be hoped that the meeting of mechanical engineers at Nashville will be well attended. The distance is quite great for many members to go, but it is a good thing to note progress outside the regular circle. It is probable that those who make the trip will be well repaid for their trouble. At the season of the year when the society meets the weather at Nashville is likely to be delightful, and the trip will undoubtedly be a pleasant one.

American Railway Master Mechanics' Association.

We learn, by circular from Secretary Sinclair, that the twenty-first annual convention of this association will be held at Alexandria Bay, N. Y., beginning at 9 A. M., June 19. The headquarters of the association will be at the "Thousand Island House."

Any desired particulars as to routes, hotel accommodations, railroad fares, etc., can be obtained of the committee of arrangements, viz.: H. M. Britton, R. W. & O. R. R., Oswego, N. Y.; R. C. Blackall, D. & H. C. Co., Albany, N. Y.; J. Davis Barnett, G. T. Ry., Port Hope, Ont.; or from the secretary, Angus Sinclair, 175 Dearborn street, Chicago, Ill.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(232) C. K., East Saginaw, Mich., asks: If an article is patented, can I make one for my exclusive use? *A.*—No, not without rendering yourself liable to a suit for infringement.

(233) A. R., Lathrop, Mich., asks: Is the point of cut-off in an automatic cut-off engine always the same, or does it vary? *A.*—The point of cut-off is being constantly varied by the governor, to suit the load and steam pressure.

(234) A Reader, Chambersburg, Pa., writes: Will you please give me rules and illustrations for finding the transmitting efficiency of turned shafting at different speeds, and under varying circumstances? I would like arithmetical rules, as I do not understand algebra, and the rules in my books are too complicated. *A.*—The probability is that we could not give you any rules of general application which would be any more simple than those you have. If you take the formulæ given in your books and substitute for the letters given in them, figures representing the values for the particular case, you will find that it is then nothing more than arithmetic and a simple matter of multiplication and division. Taking for instance a formula given for turned shafting, with power taken off at intervals, and with bearings 8 feet apart

$$H = \frac{D^3 \times R}{90}$$

Now this simply means that H, the horse-power the shaft will transmit, equals the cube of D the diameter of the shaft, multiplied by R the number of revolutions per minute, and this result divided by 90. Now, supposing we have a shaft two inches diameter running 200 revolutions per minute, then substituting these values for the letters of the formula, we have,

$$H = \frac{2^3 \times 200}{90}$$

which equals 17.7 horse-power, the transmitting efficiency of the shaft under the given conditions.

(235) W. S. S., Baltimore, Md., writes: I have occasion on some work here to either case-harden or harden by some acid process, small pieces made of machinery steel Is there not some solution they can be immersed in to case-harden, or some process by which they can be hardened in

acid or a combination of acids? The object being to avoid the two heatings necessary to successfully case-harden with cyanide or prussiate of potash. *A.*—We know of nothing into which such pieces can be dipped to harden them after being heated in the ordinary manner, but they can be case-hardened in the same way that wrought-iron is, by heating in bone charcoal and quenching in water.

(236) J. E., Cleveland, O., and "Tinker," Norwich, will find their question about turning tapers answered in our issue of April 14, Question 196.

(237) H. H., Indianapolis, Ind., will find rules for proportioning ports of cylinders in the AMERICAN MACHINIST of Sept. 5, page 5, 1885. Back numbers can be obtained of newsdealers, or direct from this office.

(238) D. D. D., Providence, R. I., asks: What is your authority for giving the depth of a square thread as 19-20 of the width? The rule generally followed, so far as my experience goes, has been to make the thread square as its name implies. *A.*—Our authority is Unwin's Elements of Machine Design, page 117. We quoted the rule from memory, however, and thus unwittingly changed the form of the rule, but without changing its significance.

(239) "Tinker," Norwich, writes: Supposing I have a gear to cut with 36 teeth, and five teeth to the inch, how can I find the diameter of blank for this gear, and for all other sizes and numbers of teeth? *A.*—It depends upon what you mean by "5 teeth to the inch," but presuming that you mean a diametral pitch of 5, the size of the blank would be found by increasing the number of teeth by two and dividing this result by the number representing the diametral pitch. In the case you mention it would be

$$\frac{36+2}{5} = 7.6 \text{ inches.}$$

The method you name is the one usually adopted for cutting large threads.

(240) J. W., Mattoon, Ill., asks: 1. How shall I proceed to put a new pair of cylinders on an old locomotive engine? *A.*—That depends on the kind of cylinder (loose saddle, or cylinder with half saddle) to be put on the boiler, also on the custom in the shop in which the engine is to be repaired. In fact, the information you ask for is part of a mechanic's profession, and can only be thoroughly learned by actual practice in the shop. 2. Is not the saddle pin on the link so placed as to get the least sliding motion of the block in the link? *A.*—The saddle pin on the link is placed so as to cut off equally in any position in which the link may be placed. 3. After the locomotive has been stripped in the shop, how can I find where to place the rocker box? *A.*—Set the valve in its central position, and then place the rocker box, so that when the rocker is connected to the valve, the upper rocker arm will stand in a vertical position. 4 What kind of a battery, how is it made, and what kind of materials are used, in which nitric acid is used to generate electricity? Give name of a book treating on electricity for beginners. *A.*—See Ganot's Physics. This is a good book for beginners.

(241) E. S., Sheboygan, Wis., writes: 1. The cams of a Corliss engine valve gear are set so as not to unhook the valves until the engine gets up to her speed or until the governor begins to act. Now, in this position, can the cut-off be prolonged by shortening and lengthening the rods? *A.*—By changing the lengths of rods, there will be a change in the speed of engine, because the plane of rotation of the governor balls will be changed. The difference of speed of engine will depend on the difference in speed to drive the governor balls in the different planes. In a well-constructed engine the height of the governor plane is determined by the designer, and all levers and rods made to correspond; consequently, when the engineer makes any changes in these rods, the constructor's labor has been in vain. 2. We have a stand pipe connected with our waterworks system, which, when pumped full, will produce a pressure of 60 pounds per square inch. Now suppose we close the stand pipe at the top, and to the top we connect a gauge, and then pump until the gauge shows a pressure of 10 pounds, how much pressure will there be at the bottom of the stand pipe? *A.*—70 pounds if the air is excluded. 3. Examining and washing out a small tug boat boiler, a spot was found of about 10 inches long and 4 inches wide which had corroded to about 1-32 of an inch. It was located inside of the fire-box on the water leg under the grates. The day before it was discovered, the boiler was carrying steam at 80 pounds' pressure. How is it that this spot withstood the pressure? Would it not have blown out if the spot had been somewhere on the top of the boiler? *A.*—The corroded spot was protected by the mud in the water leg, and would not have withstood the pressure after the boiler was cleaned, neither would it have withstood the pressure if it had been on the top of boiler.

(242) —— Tait, Detroit, Mich., writes: In a late number of your paper, I noticed the method adopted by Wm. Sellers & Co. of fastening the hammer to piston rod end of steam hammer. Will you please tell me the advantage claimed for doing it that way, and the philosophy of it, etc.? *A.*—We referred your question to Wm. Sellers & Co., who replied that we were mistaken in attributing the method described to them, and kindly favored us with a description of their method, as follows: "Our method is to make the bushing tapered on the outside and fitted tightly into a tapered hole in the head. In attaching the head we drop the split bushing or 'wedge ring' into the head, out of which it should stand about one-third of its width. The head is next put in place upon the bar, care being taken to keep the end of the bar an inch or two above its true position; the wedge ring must now be driven down by a sledge and setting tool until it is tight; when this point is reached the ring should stand about a quarter of an inch above the top of the head. The die may now be put in and a few hard blows upon the anvil will be sufficient to drive the bar home to its proper place against the hammer die." 2. In taking the correct time at observatories, are the observations taken at night from the stars, or in daytime from the sun? A professor once explained to me, as near as I can remember (for it was long ago and I was young), that time was taken from the stars more correctly than from the sun. *A.*—With the instruments used in observatories, stars can be seen in daytime, consequently, though time is taken from the stars, observers are not restricted to the night for doing it. Time can perhaps be about as accurately taken from the sun as from a star, but it is much more trouble to do so. The fixed stars never vary from correct sidereal time, which is the time mostly used by astronomers, and moreover the brightest of them, owing to their great distance, never appear in the strongest telescopes as anything more than mere points of light. The telescope merely makes them appear brighter, without increasing their apparent magnitude. This makes it unnecessary to make any correction for variation, and the actual position of the star is sharply defined, and may with comparative ease be determined. On the other hand, the sun agrees with "mean solar" or clock time, only for an instant twice each year, at all other times it is either fast or slow, and in taking a solar observation for time, this variation for the time and place of observation must be taken into account. Then the sun, unlike the stars, has a sensible apparent diameter, and owing to the constantly varying distance of the earth from the sun, this apparent diameter is constantly changing, and since, for convenience, the exact moment of contact of one limb of the sun with the cross-wires is taken, a constantly varying correction must be made to reduce the observation to the center of the sun.

(243) Young mechanic, ——, writes: A friend is building a certain kind of screw press, the screw being driven directly by pulley and belt. Wishing to build a larger size, in which greater pressure with the same pitch of screw and the same number of turns per minute is required, he asked my advice as to whether it would be better to increase the width of machine pulley and belt, or increase the diameter of the machine (driven) pulley, retaining the original width of belt. I advised him to pursue the latter course. My reasoning was that, in placing a wider belt on the original diameter of the pulley, he could only gain because of the increased strength of the belt admitting a greater tension. In other words, the increased width of bearing in the pulley did not increase its adhesion: the narrow belt would pull just as much without slip, provided it could stand the same tension as the wide belt. Of course the weight of the wider belt would be a factor in the calculation, were it not for the fact that the machine, from its peculiar construction, must be driven vertically or nearly so. As I understand this case, by using a larger diameter of pulley instead of a wider one he would gain (not power) in several ways; first, there would be an increase in leverage; second, he would gain because of the necessary increase in the velocity of the belt; and finally there would be less friction on the shaft than if a wider belt (which means a tighter belt) were used. *A.*—Your reasoning is correct and very good. By increasing the diameter of the pulley, and not changing the number of revolutions of the screw, you increase the speed of the belt, and although by this increase of diameter of pulley you do not gain any power, you certainly increase the capability of the belt to transmit power; consequently, since the machine which your friend wishes to build will require greater power to run it, the increased power required to drive it can be transmitted through the narrow belt passing over a pulley of increased diameter. 2. I studied drawing at Cooper Institute, New York. I was there taught to shade drawings as Mr. Meyer now teaches in the AMERICAN MACHINIST, that is, elevations right hand and lower lines; plans right hand and upper lines. This method seems to me to have the advantage of distinguishing the two views. I never knew of any other method until required to make patent office drawings. That institution requires all views to be shaded alike except perspective, in which case, however, the direction of the light must be the same. Would you advise me to shade shop drawings according to the method of the schools, or to shade both views alike? *A.*—It is customary in working drawings to shade all the views alike, and should always advise you to do so, unless the rules of a drawing room require the drawings to be shaded differently. If a finished general plan is to be made in which all the falling shadows are to be shown, you will find that you can follow only the correct way, namely, that taught in schools. The reason for adopting in the articles on Practical Drawing, the method of placing the shade lines in the plan or top view differently from those in the elevations is because Mr. Meyer believes this to be—although contrary to custom—the only correct way, and such a course should be adopted in teaching drawing as it will avoid confusion when the subject of falling shadows is studied. But Mr. Meyer does not wish to be understood that he condemns the customary practice of shading alike all views in a working drawing; he himself follows this practice in the drawing room.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See adv., page 16.

Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link Belt Machinery Co., Chicago and N. Y.

Taper attachment on all lathes Lodge, Davis & Co.
Compound rest on all lathes Lodge, Davis & Co.
Power cross-feed on all lathes Lodge, Davis & Co.
Large hollow spindle on all lathes Lodge, Davis & Co
Automatic stop on all lathes Lodge, Davis & Co.
See special ads. pages 15 and 16 Lodge. Davis & Co.

Shafting Straighteners. J. H Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 56 Beekman street, New York.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Improved fine tools for mechanics, manf'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortland st., N.Y.

The bulldozer, a new departure: forging by pressure. M't'd by Williams, White & Co., Moline, Ill.

Silk wiping towels are better and cheaper than waste. S. A. Smith, 23 South Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See April 14, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston Mass.

Robertson's damper regulator; no diaphragms, springs or packing; the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st, N.Y

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Accurate Cam Cutting—Specialties in fine light machinery, patented articles in line of machine work. Wardell S. M. Co., Woonsocket, R. I.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity

Parties requiring milling machine or screw machine work turnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot water apparatus for domestic and general purposes. By F. Dye. 82 pages with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 12 Cortlandt street, N. Y.

James D. Cardell & Co., 1900 Passyunk ave., Philadelphia, Pa., boiler makers, manufacturers of tanks, stacks, and all kinds plate iron work; coils of wrought-iron pipe for ice machines, blast furnaces, paper mills, dye houses, etc., also coil boilers.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2. postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 7, 1888 issue 47 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

MANUFACTURES

The Chattanooga, Tenn., plow factory expect to enlarge their works.

The Southern Nail Company are building a nail factory at Decatur, Ala.

C. W. England is interested in building a plow and a stave factory at Lonoke, Ark.

A. J. & W. R. R. Kinett, Oxford, N. C., will add new machinery to their machine shop.

The Fisher Manufacturing Company, fancy cottons, Fishersville, Mass., will build an addition to their mill 100 x 165 feet.

The Western Electric Company will build a factory to cost $200,000, at the corner of Greenwich and Thames streets, New York.

The Ohio and Mississippi R. R. Company will remove their roundhouse and repair shops from Jeffersonville, Ind., to Louisville, Ky.

Trübner & Co., 57 and 59 Ludgate Hill, London, E. C., England, send us a catalogue of works on applied science. Their list is quite complete.

The sash and blind factory at South Hadley, Mass., destroyed by fire last January, will be rebuilt at once. J. W. Gaylord is one of the owners.

The mower and reaper works of William Anson Wood at Youngstown, Ohio, was recently destroyed by fire which originated from natural gas used in the foundry.

The Beals Brake Company, of 16 Exchange place, New York, are starting a factory at Norwich, N. Y., under the management of Mr. E. Beals, the inventor of their brake.

The town of Warren, Mass., has voted to exempt from taxation for ten years any manufacturing industry with a capital of $20,000, that will locate at the Upper Falls.

H. K. Porter & Co., Pittsburgh, Pa., are busy on small locomotives. They build small locomotives for all purposes, one just shipped being 20 inch gauge. They are also building a number of street car locomotives.

The New Home Sewing Machine Company, Orange, Mass., are increasing their facilities for manufacturing They have recently put in the Waterhouse system of electric arc lighting. They have, so far, put in 75 lights.

The Austin (Texas) *Weekly Statesman* says: Texas is waking up to the proportions of a bantling manufacturing boom. Austin herself soon proposes to collect the waters of the Colorado in a canal, and plant a couple of million dollars in manufactories.

The Taylor Manufacturing Company, Chambersburg, Pa., report good business in their "Beck" automatic engine, which they say is giving excellent satisfaction wherever used. Cooke & Co., 22 Cortlandt street, New York, are general agents for the sale of this engine.

The Humphrey Manufacturing Company, Towanda, Pa., will, owing to large increase in business, build a foundry and machine shop. They build saw and grist mill machinery, lath mills, pulleys, hangers, couplings, etc., and deal in engines, boilers, pipe and fittings and other supplies.

There is water-works agitation at the following places: Burrillville, R. I.; Franklin, N. H.; Warrior Station, Ala.; Orleans, Neb.; Little Falls, N. Y.; Parkdale, Can.; Natrona, Pa.; Carterville, Mo.; Centreville, Md.; Batesville, Ark.; Ellensburg, N Y., Clyde, N. Y.; Madison, Fla.; Nashville, Tenn.; Minneapolis, Minn.; Fort Riley, Kan.; Helena, Mont. Brady, Tex.

The Acme Machinery Company, Cleveland, Ohio, have issued their 1888 catalogue of bolt cutters, nut tappers and special machinery. The catalogue, in addition to the usual cuts and descriptions of machines, contains valuable information on making dies, and on the proportion of master or hob taps. On the cover of the catalogue is a cut of a large screw, nearly square thread, ½ inch pitch, cut with the Acme machine, which shows its capacity for that kind of work.

The Laidlaw & Dunn Company, Cincinnati, Ohio, recently shipped a large order to Sydney, Australia and have recently sold one of their large duplex pumps to Mr. Mashima, who is in this country from Japan, buying machinery. They have also contracted with the commissioners of the Centennial Exposition of the Ohio Valley and Central States to furnish them with their pipe, fittings and valves to be used in fitting up the engines, boilers, etc. Also all the material for the steam and water heating in the new Chamber of Commerce in Cincinnati.

The reorganized firm of Alex. McGee & Co. (St. Louis, Mo.), now the McGee, Lattimore & La Barge Manufacturing Co., with a capital of $25,000, will greatly enlarge their plant and list of specialties; To this end a new building will be erected just back of the present factory, on the unoccupied portion of the company's lot, with dimensions 45 by 55 feet, and two stories high. The new lines, which such additional space and capacity will enable the company to make, will consist of sash and door machinery, moulders, tenoners, mortisers, etc.—*The Age of Steel.*

Henry R. Worthington, New York, has issued the following special notice: Owing to recent improvements made in the design and construction of many sizes of Worthington steam pumps, special attention is called to the necessity of stating in all orders for repair parts, the shop number as well as the size of the pump for which the parts are required. The parts illustrated in our general catalogue of Dec. 1, 1887, are of the new pattern pumps, all of which are numbered above 30,000; but a separate sheet will be furnished to illustrate and describe repair parts for pumps of the older patterns.

Machinists' Supplies and Iron.

NEW YORK, April 19, 1888.

Iron—American Pig—No. 1 X Foundry $20.50 to $21 for small lots immediate delivery. No. 2 X Foundry, $18.50 to $19.50. Gray Forge $16 to $17.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page eleven.

Wanted—A situation by an experienced draftsman. Address Mechanic, AM. MACHINIST.

Tool maker desires to make change; young man 27; A1 on small tools and automatic machines. Box 97, AM. MACHINIST.

First-class steam engine erector capable of handling men, wishes to change position; best references. Address Box 98, AM. MACHINIST.

Situation wanted in New York or Brooklyn by a first-class draftsman on marine engine or general work. H. P. A., AM. MACHINIST.

Wanted—First-class draftsman familiar with pipe foundry details. Address with references and full particulars, M. F., AM. MACHINIST.

A good mech. draftsman wants to change position, if something permanent and prosperous is offered. Correspond with "A," AM. MACHINIST.

Wanted—Foundry foreman for general machine work. Address, stating age, experience, salary expected and references, B. B, AM. MACHINIST.

Wanted—Position as foreman by first-class moulder; understands all branches in the iron foundry; 14 years' references. H., AM. MACHINIST.

Situation wanted as master mechanic or erector, by experienced man, on all kinds of millwright machinery; first-class references. Address T. Carliss, Stamford, Ct.

Wanted—Position as machine shop superintendent by first-class designer and draftsman, with extensive and varied experience in steam engine, locomotive, marine and mining work, etc. Address Wm. Y. Silver, Box 8, Trinidad, Col.

Wanted—Position as foundry foreman or assistant; at present assistant in one of the largest foundries; understands heavy and light work; would like change; temperate; best of references. Address F. E. Homier, 537 Broome street, N. Y. City.

Designer and draftsman, able to design a new line of first-class machine tools, drop hammers, turbines, hydraulic motors, hydraulic rams, centrifugal pumps and mechanical specialties, desires engagement. Address R. P., 225 Erie St., Cleveland O.

Wanted—A situation as superintendent or foreman in a manufacturing concern, by a superintendent of several years' experience; accustomed to managing men, and taking entire charge of manufacturing; technical education. Address with full particulars, Lock Box 11, Chester, Mass.

Machinist Wanted—An intelligent young machinist with $2,000 is wanted to purchase one-half interest in a light machine manufacturing business which is well established in Boston. He must take charge of machine work, and in addition to his share of profits will receive fair wages. Address L. G., care AM. MACHINIST.

Wanted—Foreman for a large foundry in North Alabama; also foreman for pattern shop, and bookkeeper for the works. The capital stock of the company is one hundred thousand dollars, and the works in active operation. Each person will be required to take from 3,000 to 5,000 stock in the company. Address P. O. Box P, New Decatur, Ala.

Wanted—Experienced and competent canvassers and salesmen for steam appliances, who are already on the road among steam users, and would interest themselves in introducing on commission a system not in conflict or competition with their existing engagements. Address The Hussey Re-Heater and Steam Plant Improvement Co., 15 Cortlandt st., N. Y.

A man who has been six years with the leading firm of Corliss engine builders, employed both in office and on the road, and is familiar with all their standard work, pumping and blowing machines, wishes to make a change, and is open to engagement to build a line of Corliss engines, for general office work, or to travel; is a practical mechanic. Address Corliss, AM. MACHINIST.

✝ MISCELLANEOUS WANTS. ✝

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none, price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Inventors, attention—Would like to buy or manufacture on royalty some small patented article. Address Box 2101, Bridgeport, Conn.

For sale, cheap. A pair of engines, new, 2⅛"x2½"; balance valve and link motions; $75 cash. Address 1313 Third avenue, Beaver Falls, Pa.

Wanted—To correspond with parties having specialties to manufacture in the foundry or machine line. "Manufacturing," AM. MACHINIST.

Wanted—The address of E. Lawrence, and others, who want our new catalogue of small tools. E. H. Randall & Co., 154 Lake street, Chicago, Ill.

Wanted—To correspond with parties having specialties to manufacture, small machinery and pat'd articles. Address "Natural Gas," AM. MACHINIST.

Wanted—Specialties in light machinery, hardware and novelties in the hardware line, to manufacture for the Canadian market on royalty, or by contract. Address, Box 595, Ingersoll, Ont., Can.

August C. Christensen, 26 Church st., N. Y., mech. and hydr. engineer. Prepares designs of waterworks pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

For Sale—One complete set of pulley moulding machinery to make pulleys from 6 inch to 40 inch; one 9 ton cupola; three foundry cranes; one sheet-iron core oven; crane hand ladles from 40 pounds to 7,000 pounds; complete with necessary bales and handles. Address North Star Iron Works, Minneapolis, Minn.

Wanted Partner—A splendid opportunity to a machinist or pattern maker who can furnish tools for machine shop in connection with foundry in successful operation, situated in the center of a sugar growing region, an extensive lumber manufacturing town; no foundry within 100 miles. Address Box 107, Plaquemine, La.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

Bradley's HEATING FORGES

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

Pat. Aug. 30, 1887

For hard coal or coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES.

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

TO MACHINERY MANUFACTURERS.

Having a first-class Machine Shop and Foundry, the latter nearly new, we would like to correspond with parties wishing to extend their business.

HARRIS MANUFACTURING CO.,
Providence, R. I

TANITE EMERY WHEELS and GRINDING MACHINES

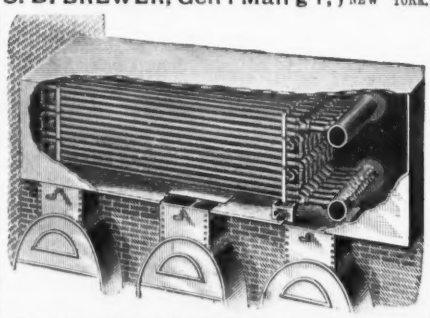
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS.

For Circulars address THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.

Or H. A. ROGERS, 19 John St., N. Y.

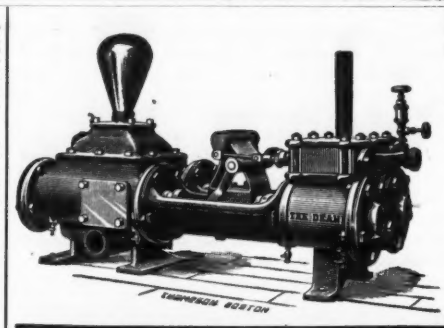
THE HUSSEY RE-HEATER and STEAM PLANT IMPROVEMENT CO.

A. S. HATCH, President, } 15 Cortlandt Street, NEW YORK.
S. D. BREWER, Gen'l Man'g'r, }



Engineering, Steamfitting, and Designing, Remodeling and Improving Steam Plants. Consulting experts in all matters pertaining to the use of Steam and Heat.

THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER



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FOR ALL PURPOSES.
SEND FOR CATALOGUE.

MACHINE TOOLS ON HAND FOR IMMEDIATE DELIVERY.

15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers. 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

STEEL

In BARS, BLOCKS, SHEETS, RODS and WIRE of the finest quality used for TOOLS and DIES of every description. MACHINERY, SPRING and all other grades for general purposes.

MILLER, METCALF & PARKIN,
Pittsburgh, Pa. Chicago, Ills. New York, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND LATHES POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.

OUR NEW 18 In. POWER ENGINE LATHE IS NOW READY

McMAHON & COMPANY,
MANUFACTURERS OF

Machinists' Tools,
AND
Patent Friction Pulleys.
Water St., Corner Ledge,
WORCESTER, - - MASS.

"Star" Foot Lathe Swings 9x25 in. | Screw Cutting Automatic Cross Feed, etc.

LATHE

Scroll Saws, Circular Saws, Lathes Mortisers. | Catalogue Free of all our Machinery

Seneca Falls Mfg. Co. 767 Water St., Seneca Falls, N.Y.

MACHINE TOOLS.

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

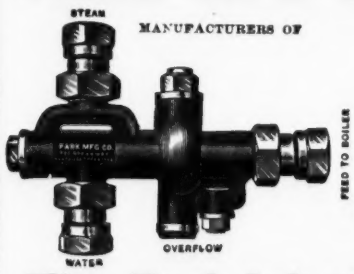
Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England.

BALDWINSVILLE CENTRIFUGAL PUMP WORKS.
IRVIN VAN WIE, Prop.,
SYRACUSE, - N. Y.

VERTICAL, Horizontal & Suction Pumps.
Capacity 100 to 40,000 gals. per minute.
Sand Pumping Outfits a Specialty.

PARK MFG. CO.

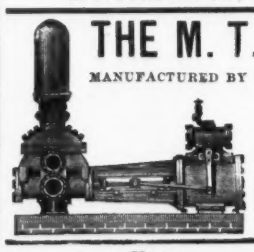


MANUFACTURERS OF
34 Beach Street, Boston, Mass.
The Park Injector,
EJECTORS AND JET APPARATUS.

COOKE & CO., Dealers in
MACHINERY AND SUPPLIES,
22 CORTLANDT ST., NEW YORK,

AGENTS FOR
The Waters Perfect Governor.
Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also,
SUPPLIES
For Machinists, Railways, Mills, Mines, Etc.
Please send for circular and state that you saw the advertisement in this paper.

THE M. T. DAVIDSON IMPROVED STEAM PUMP
MANUFACTURED BY
DAVIDSON STEAM PUMP COMPANY.

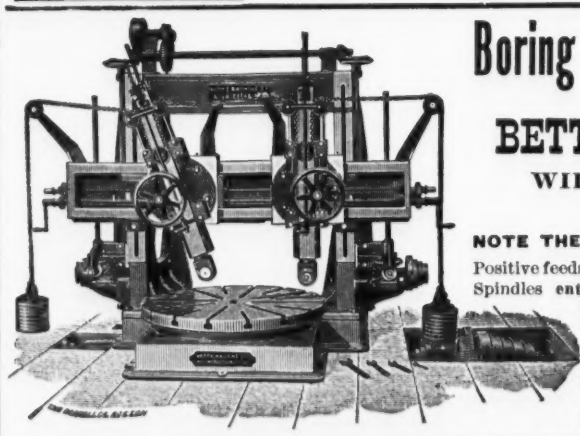


WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.
PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

GEO. F. BLAKE MANF'G. CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING ENGINES A SPECIALTY

Boring and Turning Mills
MADE BY
BETTS MACHINE CO.
WILMINGTON, DEL.



NOTE THE FOLLOWING ADVANTAGES.

Positive feeds, no friction.

Spindles entirely independent, can be moved simultaneously in opposite directions with different grades of feed.

Spindles not round, but of such shape as will allow ready adjustment for wear.

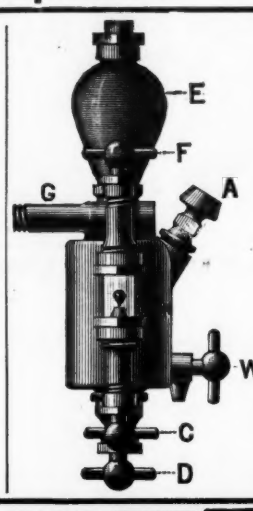
Great range of feed and abundance of power.

Send for list of machine tools on hand for immediate delivery.

NICHOLSON FILE CO., Providence, R. I.

Manufacturers of FILES and RASPS.

In Quantity, greater than
In Quality, superior to } **any other Maker.**
In Variety, far ahead of
In Reputation—No File sells so easily.



THE "VOLUNTEER" UP-DROP, SIGHT FEED, LUBRICATOR,

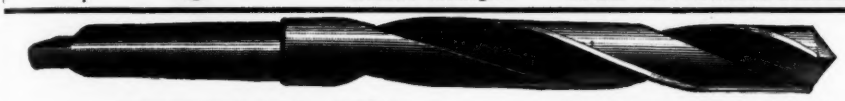
(GATES PATENT.)

For Stationary Engines and Pumps of all kinds. Lubricators for Single or Double Connection.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

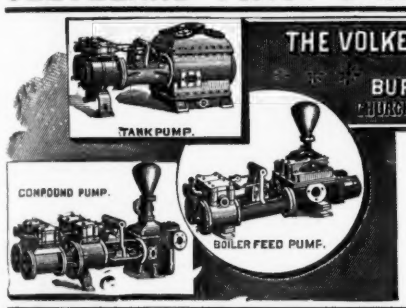
NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,
Send for Catalogue. SOLE MANUFACTURERS.



Established in 1874.

CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.



THE VOLKER & FELTHOUSEN M'F'G. CO.
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
CHURCH, BIRD & ALL & MECHANIC STS. BUFFALO, N.Y.

For Sale at Factory Prices by

A. Aller, New York; S. C. Nightingale & Childs, Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks & Co., Detroit; Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; Pond Engineering Co., St. Louis and Kansas City; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O. C. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.

Hall

HALL STEAM PUMP CO.,

Steam

WHAT USERS THINK OF THE

We have used your pumps on many of our elevators, some working up to 200 lbs. water pressure, and find them especially well adapted for the service. They are the most reliable and quiet, and the least complicated; they make no short strokes when pumping water or air, so require no extra air pump. We believe them most economical in the matter of steam and repairs. Our customers who have them in use are highly pleased with them. We recommend them unhesitatingly in every way.
WHITTIER ELEVATOR CO., New York, N. Y.

Duplex

91 LIBERTY STREET, NEW YORK.

Pump.

WHY THIS IS PUT HERE!

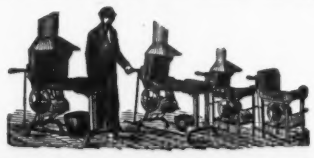
For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

NEW PULSOMETER,

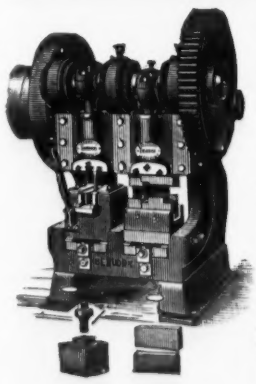
THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.
More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.
Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.
PULSOMETER STEAM PUMP CO., 120 LIBERTY ST., N. Y.

P.H. & F.M. ROOTS,

Connersville, Indiana,
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.



ROOTS' NEW ACME HAND-BLOWERS.
Slow-speeded, Force-blast. Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. } 22 CORTLANDT ST.,
COOKE & CO., Selling Agts., } NEW YORK.
In Writing, Please Mention This Paper.



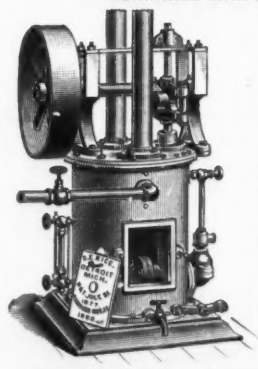
BEAUDRY'S DUPLEX Power Press
COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.
(Formerly of Beaudry's Upright Power Hammer,)
Sole Manufacturers.
Also manufacturers of HARD COAL HEATING FORGES.
Room 4, MASON B'DG, 70 KILBY ST., Boston, Mass.

JOHN WILEY & SONS, 15 ASTOR PL. NEW YORK.

—PUBLISHERS OF—
SCIENTIFIC AND INDUSTRIAL WORKS.
Send for Catalogues and Circulars.—Free by mail.

RICE'S PATENT
FEED-WATER HEATER AND PURIFIER,
Combined with PUMP.



After 10 years' existence is still unequalled for durability, efficiency and economy. Manufacturers should carefully inquire whether their motive power is generated with all possible economy. Investigation costs but little time and will be very remunerative.

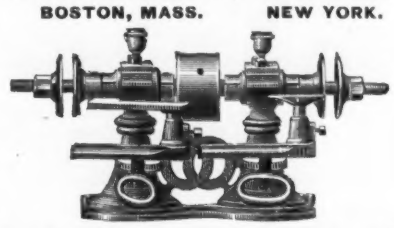
Send for Descriptive Pamphlet.
FRANK M. CLARKSON, Detroit, Mich.
EASTERN AGENT,
WILLIAM H. BAILEY,
41 Dey Street, NEW YORK.

Sterling Emery Wheel Co.,
—L. BEST, Manager,—
MANUFACTURERS,
92 Warren Street, New York.

Our Wheels for Machine Shop Work and Tool Grinding superior to all others.

UNION STONE COMPANY,

38 & 40 HAWLEY ST., BOSTON, MASS. 36 JOHN ST., NEW YORK.



No. O.—Bench Grinder, ¾ in. Arbor. Takes wheels to 12 in. diameter.

Adapted to light grinding, such as tools for wood working purposes, moulding Cutters, Bits, Saws, &c., &c.

Hand and Lathe Diamond Tools for dressing and shaping the faces of Emery or Corundum Wheels

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C. W. LE COUNT,

South Norwalk, Conn.

This Dog has a Very Heavy Pose, so that if the thread we are a Heavier Screw can be substituted.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.30
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$23.00
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

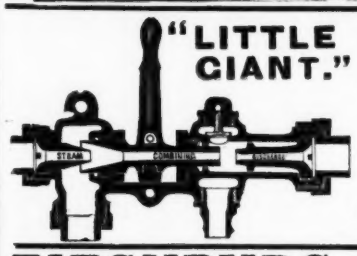
Le Count's Heavy Steel Dog.
With Steel Screws, Lathe Made and Hardened
When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.

One Small Set of 8—by 1-4 inches to 20 inch, - - - $ 6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in. 13.25

DRILLING MACHINES.

ALL STYLES WITH
Latest Designs and Improvements.
For cuts and prices address,
BICKFORD DRILL CO.,
Front & Pike Sts., Cincinnati, O.

Dean Bros Steam Pump Works.
Indianapolis, Ind.
Boiler Feeders. Duplex Pumps,
Fire Pumps, Send for Catalogue



"LITTLE GIANT." THE BEST **INJECTOR.**

For Feeding all Steam Boilers.

RUE'S EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

RUE M'F'G. CO., PHILA., PA.
CATALOGUES FREE.

FITCHBURG MACHINE WORKS.

Manufacturers of
METAL-WORKING MACHINES.
Office and Works,
13 to 21 Main Street,
FITCHBURG, MASS.
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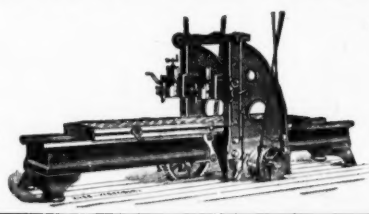

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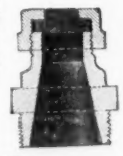

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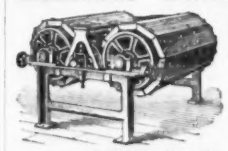

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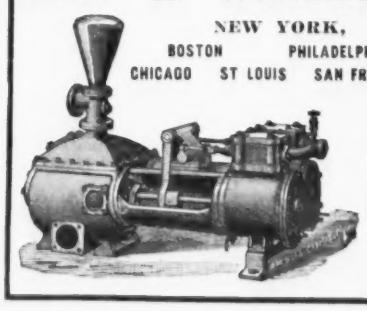

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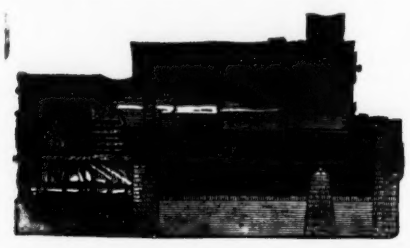

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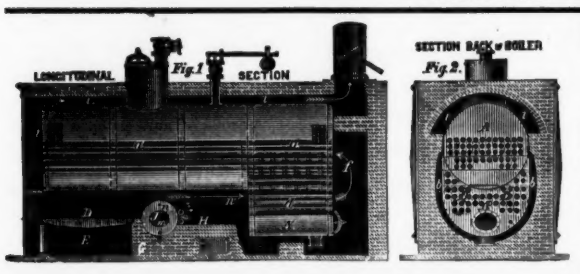

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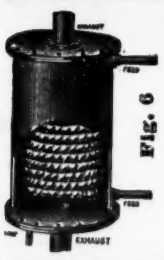

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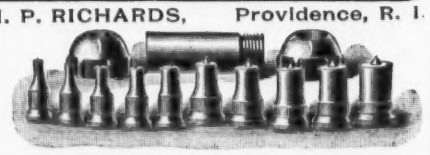

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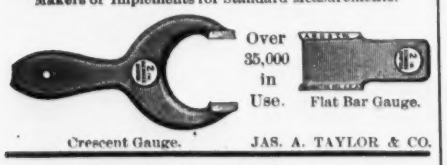

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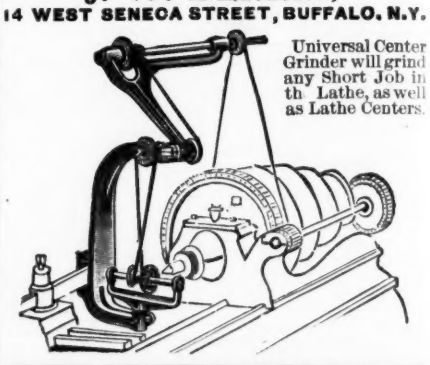

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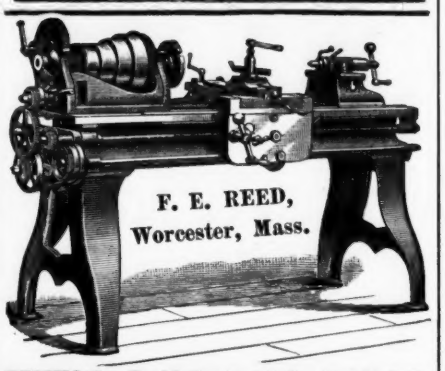

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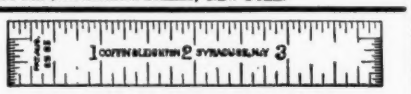

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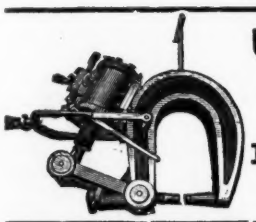

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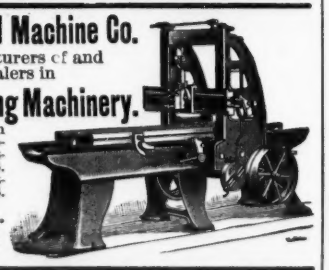

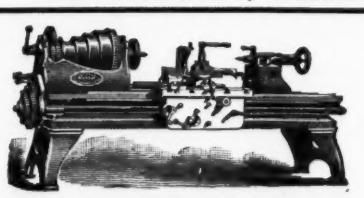

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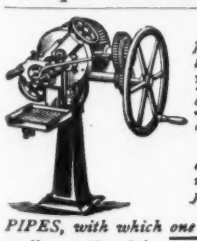

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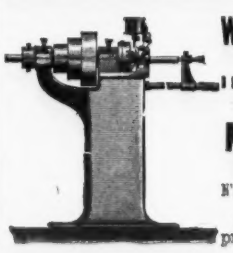

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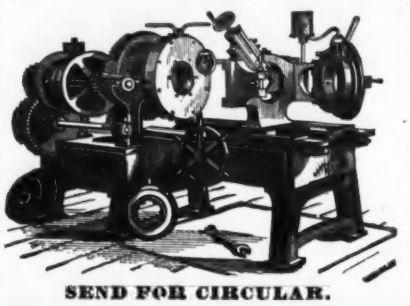

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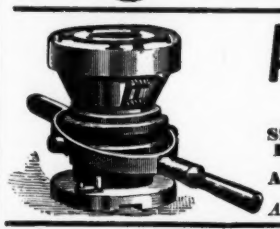

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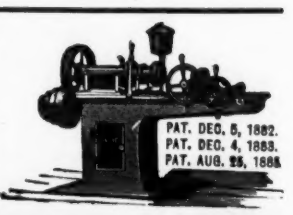

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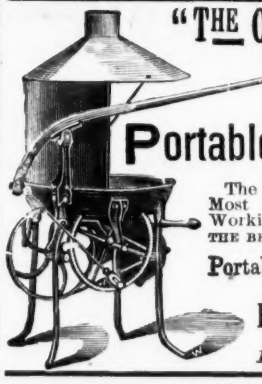

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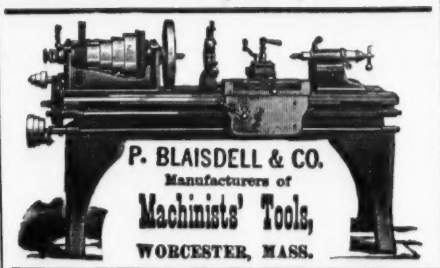

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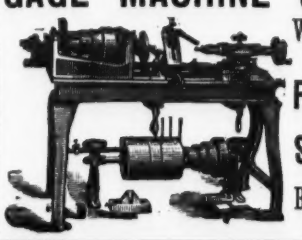

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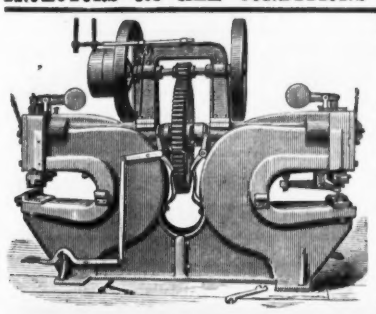

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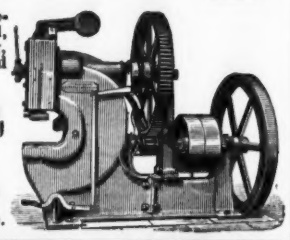

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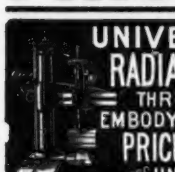

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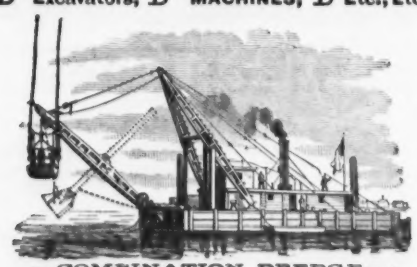

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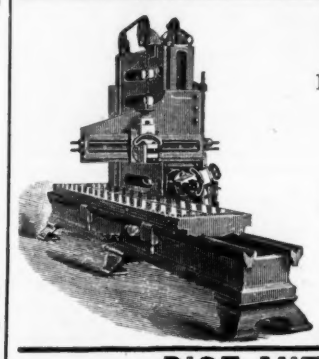

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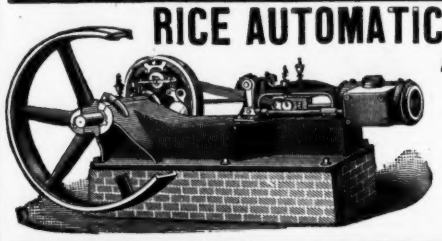

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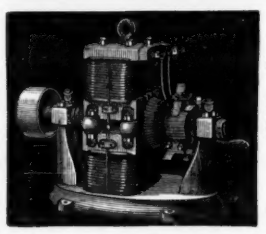

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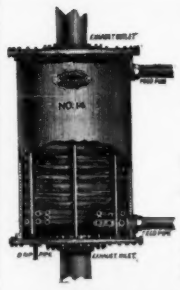

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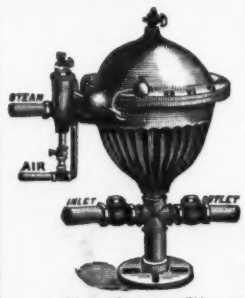

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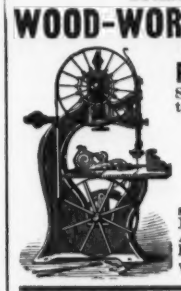

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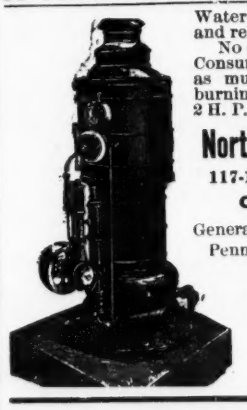

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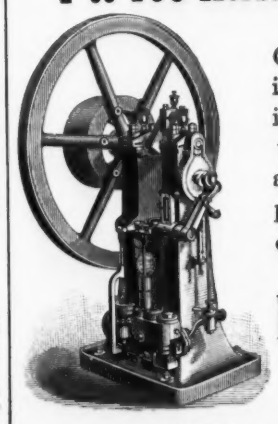

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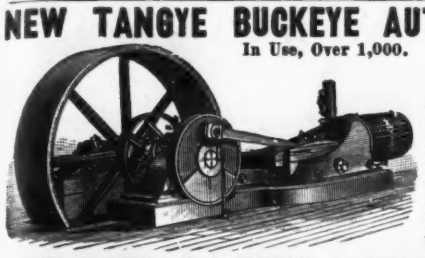

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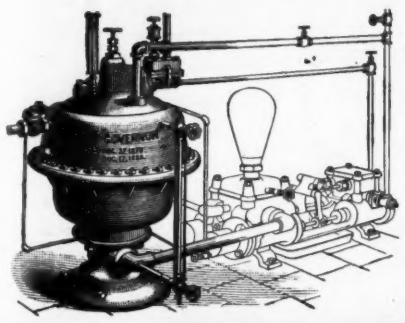

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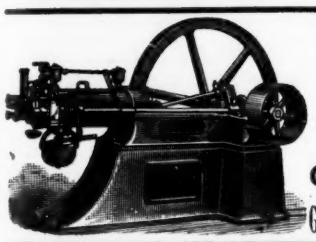

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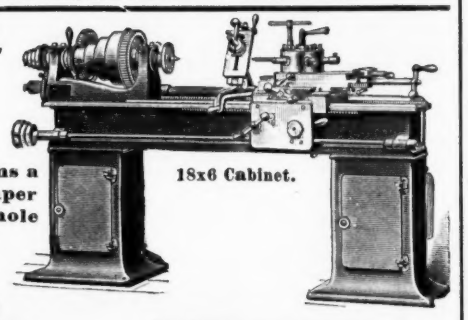

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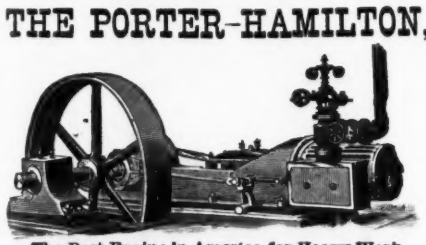

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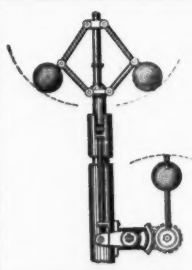

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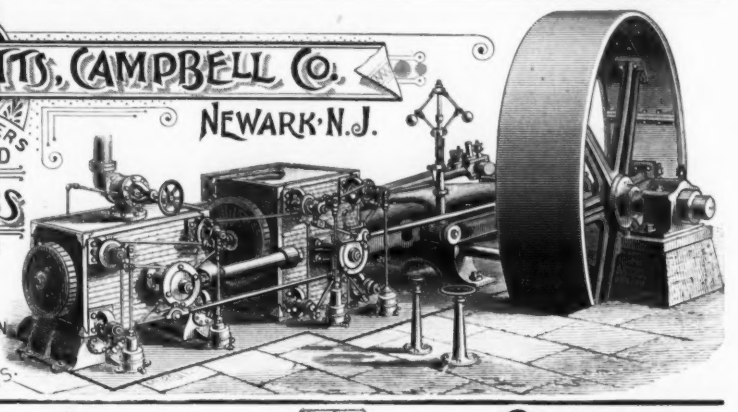

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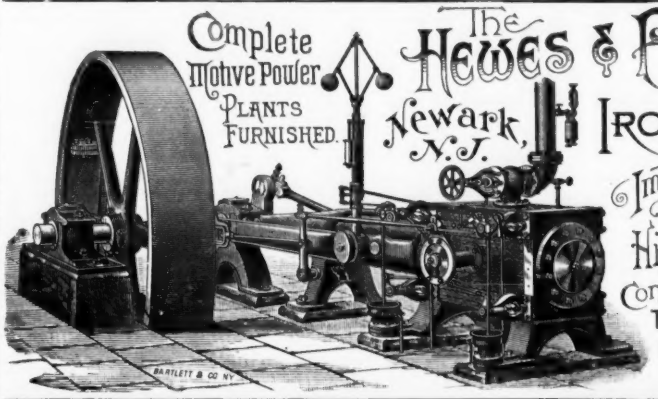

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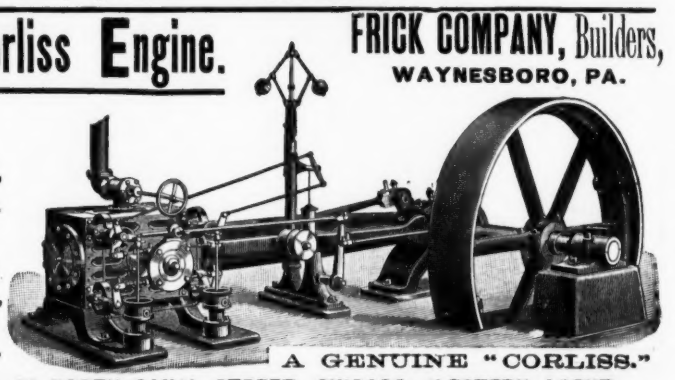

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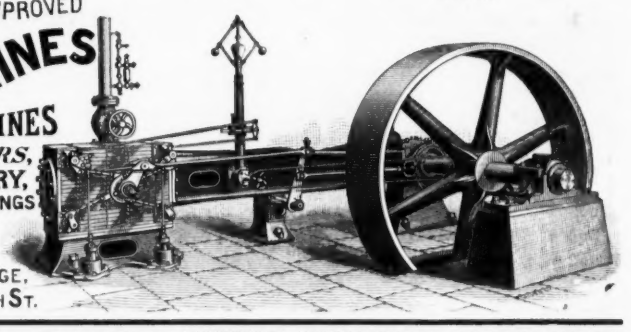

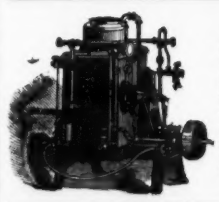

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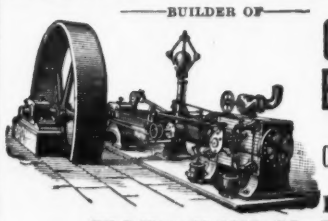

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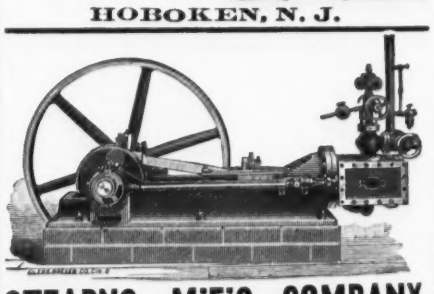

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Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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14, 15, 16, 18, 20 and 24 Inch Swing.

Any length of Bed up to 20 feet.

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Fine Workmanship.
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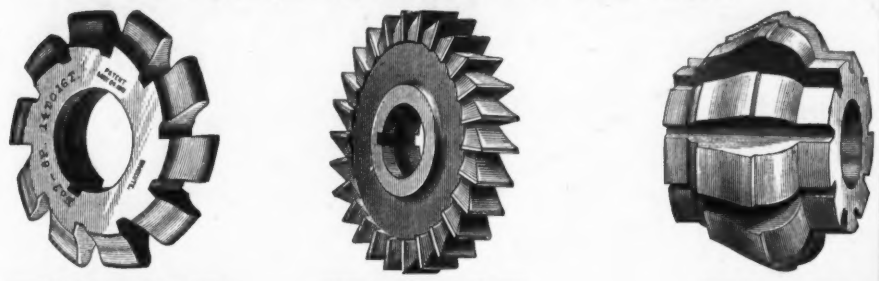

INVOLUTE GEAR CUTTER. SIDE MILLING CUTTER. FORMED CUTTER.

Coincident with the rapid and wide extension of the use of Milling Machines, has come an increased demand for Milling Cutters. Without good cutters, the efficiency of Milling Machines is much abridged.

In extending the product of its Milling Department, the BROWN & SHARPE M'F'G Co. has made many new varieties of Milling Cutters, and in order to supply the wants of customers, has found it necessary to greatly increase the number carried in stock. The INVOLUTE GEAR CUTTERS in stock are from 3 to 48 pitch, 8 cutters to each pitch. The Epicycloidal are from 2 to 10 pitch, 24 to each pitch. The curves of gear cutters are obtained by machinery. SIDE MILLING CUTTERS, from 3 1-2 in. to 8 in. diameter, are carried in stock. On work having parallel surfaces, these cutters may be used in pairs. FORMED CUTTERS, for cutting various outlines, are made to order. These, as also the Gear Cutters, can be sharpened without changing their original form—a feature appreciated by those producing work in duplicate. By making cutters in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. Users of cutters will generally find it more economical and satisfactory to purchase from experienced makers, rather than to attempt to manufacture for themselves. Catalogues mailed on application. All kinds of cutters made to order.

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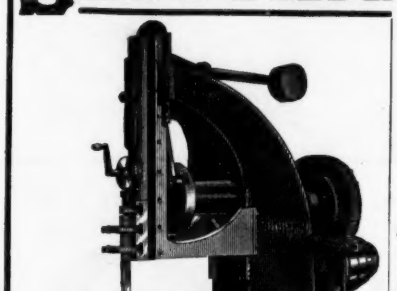

9 to 48 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

Feed always takes place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

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JENKINS STANDARD PACKING TRADE MARK

CALLED THE STANDARD—As it is the Packing by which all others are compared.

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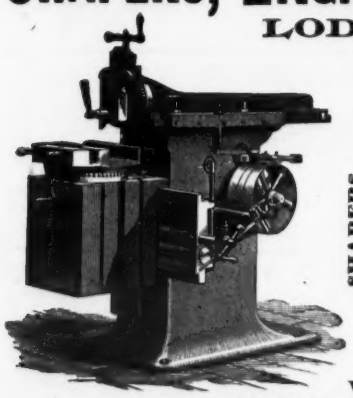

20 inch Upright Drills. 25 inch Back Geared.
24 " and
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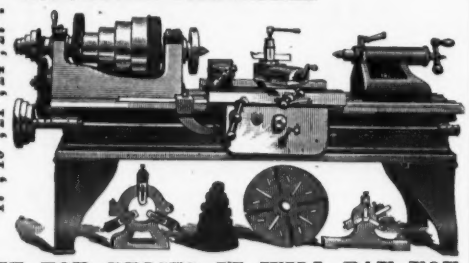
SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27".



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(See special notice of Engine Lathes on page 15.)

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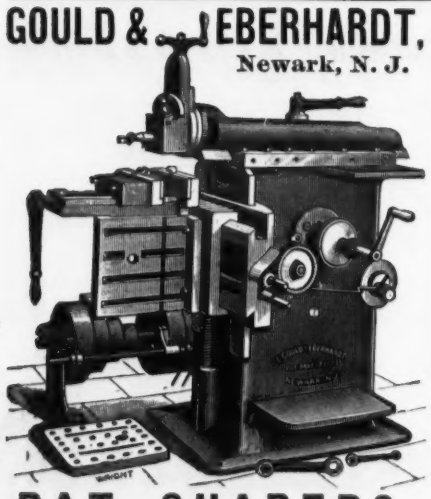

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Sizes, 10", 15", 20", 25" and 30" in stock.

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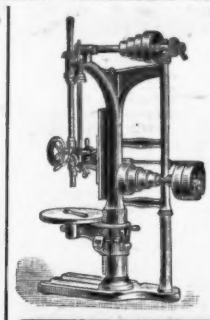

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IN 12 SIZES 3/8 UP TO AND INCLUDING 4 IN. ALSO CLAMP AND DIE DOGS

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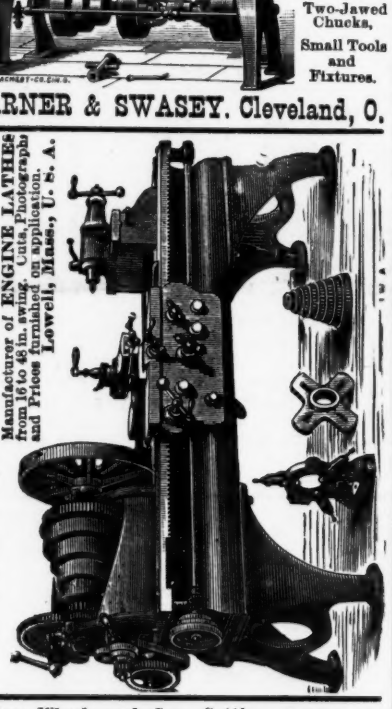

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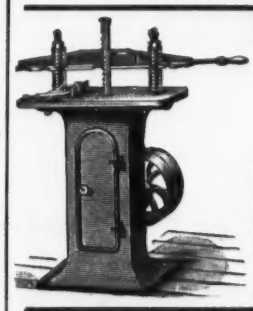

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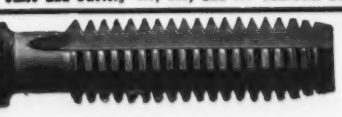

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